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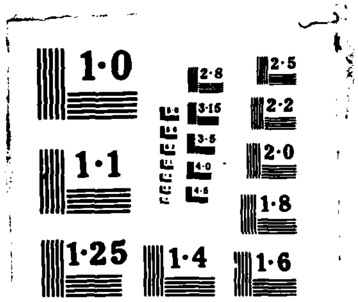
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WISWELL, INC.

3280 POST ROAD, SOUTHPORT, CONN 06490 203-259-5204



# REPORT & RECOMMENDATIONS ON UNDERWATER DAMAGE ASSESSMENT PIER LIMA NAVAL STATION, GUANTANAMO BAY, CUBA



SEPTEMBER 1979



DEVELOPED FOR
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
WASHINGTON NAVY YARD
CONTRACT N62477-79-C-0837



UNDERWATER SERVICES
CONSULTING
ENGINEERING

SITE SURVEYS
CONDITION REPORTS

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Structural assessment and repairability of the steel "H"-piles supporting Pier Lima, Naval Station, Guantanamo Bay, Cuba are presented. Field data gathering techniques included underwater ultrasonics, underwater and above surface visual inspection and measurement, still photography, and underwater (Con't)

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television. Areas of inspection included existing pile jackets, detailed underwater inspections of piles, pile-pile cap connections, and the existing fender system.

Analysis was conducted using field data and government-furnished information.; Scope of work was limited to assessment of piles on singular basis, with pier system comments and conclusions included in general terms. The pier was ground to have only approximately half of its original capacity. Re-jacketing most of the piles with concrete jackets, re-securing pile-pile cap connections, and installation of a new fender system and batter piles is recommended as a cost-effective repair to bring the pier to approximately 90 percent of its original capacity.

WISWELL, INC.

3280 POST ROAD, SOUTHPORT, CONN. 06490 203-259-5204

October 2, 1979



Naval Facilities Engineering
Command
Chesapeake Division
Building 57
Washington Navy Yard
Washington, D. C. 20374

Attention: Lcdr. T. R. Brandenburg

Re: Contract No. N624477-79-C-0387
Inspection of Piling, Pier Lima,
Naval Station, Guantanamo Bay,
Cuba

Gentlemen:

Relative to our final report, on above referenced project, dated September 1979, please note the following erratum and/or changes:

1. Page 14, line 23...delete "stainless"

2. Page 18...delete "316 stainless"

3. Page A-17, line 1...change "Fasteners" to "Bolts"

4. Page A-18 should have been transposed with page A-21 (i.e. bents 51-55 should have been in the beginning of the appendix).

5. Page A-25, line 1...change "BJD" to "DBJ"

6. The last two pages, the reference page and the bibliography page should have been bound between p. 23 and the Appendix 1 title page.

Sincerely,

George C. Wiswell, Jr., P.E.
President

GCW:vs
UNDERWATER SERVICES

Correction Discussed w/ Wiswell 2 Oct 79.

(Wiswell will include in errata sheet.)

1. P. 14, 3rd ¶, 4th line — delete the word "stainless."

2. P. 18, Fig. 2, notation for bolts, delete the words "316 stainless"

3. P. A-25 change "BJD" at top of sheet to "DBJ".

Memo

From: S.C. Ling 25 Sept. 79

To: FPO-1E, 1EA21, 1EA23

Subj: Pier Lima, GTMO — Wiswell Insp. Rep't

1. This is Wiswell's final report. It is suppose to contain all our requests following the review of their draft report.

2. To expedite in house review and hold the number of unmarked copies for distribution to NAVSTA GTMO and LANTDIV, it is requested that you not mark the attached copy. Instead write your comments on a separate sheet and return to me by C.O.B. 26 Sept 79, Wed.

[signature]



(Review copies:

1 C. Chern

1 J. Stamm

1 J. Baker

1 S. Ling

Rec'd on 25 Sept. 79

1 Reproducible of the text (original).

1 copy of text w/ original photographs (bound)

4 copies of text w/ xerox copies of photographs } (bound)

WISWELL, INC.

3280 POST ROAD, SOUTHPORT, CONN 06490 203-259-5204

September 20, 1979

Naval Facilities Engineering
Command
Ocean Engineering & Construction
Project Office
Washington Navy Yard
Washington, D.C. 20374

RE: Contract Number N62477-79-C-0837

Gentlemen:

Attached please find the results of our inspection, calculations, and analysis performed under the above-referenced contract.

We feel that this material represents a most cost-effective study within the existing scope of work.

Thank you for the opportunity of being of service.

Sincerely,

George C. Wiswell, Jr., P.E.
President

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## FIGURES AND PHOTOGRAPHS

## ABSTRACT

Structural assessment and repairability of the steel "H"-piles supporting Pier Lima, Naval Station, Guantanamo Bay, Cuba are presented. Field data gathering techniques included underwater ultrasonics, underwater and above surface visual inspection and measurement, still photography, and underwater television. Areas of inspection included existing pile jackets, detailed underwater inspections of piles, pile-pile cap connections, and the existing fender system.

Analysis was conducted using field data and government-furnished information. Scope of work was limited to assessment of piles on singular basis, with pier system comments and conclusions included in general terms.

The pier was found to have only approximately half of its original capacity. Re-jacketing most of the piles with concrete jackets, re-securing pile-pile cap connections, and installation of a new fender system and batter piles is recommended as a cost-effective repair to bring the pier to approximately 90 percent of its original capacity.

## INTRODUCTION

This report is the final product of the engineering services, provided by Wiswell, Inc. to assess the structural condition and repairability of the structural steel "H"-piles supporting Pier Lima at the Naval Station, Guantanamo Bay, Cuba. This assessment includes underwater inspection and documentation, assessment of available past inspection data and drawings of the pier and other Government furnished information, engineering calculations, and the determination of repair techniques including a cost and time estimate for the repairs to be made.

This assessment was conducted under Contract No. N62477-79-C-0387 with the Department of the Navy, Chesapeake Division, Naval Facilities Engineering Command through the Ocean Engineering and Construction Project Office. Wiswell, Inc. personnel conducted onsite inspections from July 31 thru August 3, 1979.

The objective of this project is to assess the structural condition and repairability of the steel "H"-piles supporting Pier Lima. To accomplish this assessment, inspections were made of existing pile jackets, underwater conditions of the steel "H"-piles, pile-pile cap connections, and the fender system. The information gathered on the conditions encountered is presented in the text of the report and in Appendices I, II, III, IV, VI, and VII.

## BACKGROUND

A detailed underwater inspection was conducted of Pier Lima, Guantanamo Bay, Cuba from July 30 thru August 3, 1979. This inspection included a detailed ultrasonic inspection of some 16 piles as well as basic inspection of the remaining piles in the structure. Also inspected was the pile deck itself, fender pile system, and other factors contributory to the integrity of the structure.

After the piles to be inspected,using ultrasonics were chosen, the piles were cleaned at three elevations. These elevations were directly under the pile jacket, at the mudline, and at a distance approximately half way between these two locations. At each elevation the piles were cleaned of biofouling and oxidation down to clean metal. This cleaning was done on one flange and one side of the web at each location with additional cleaning of the opposite flange at the upper elevation. This cleaning was done for a band 6 inches to a foot wide. This cleaning allowed not only an accurate visual inspection of the structural steel but also allowed a clean, corrosion-free surface for the ultrasonic testing.

Once the pile had been cleaned the diver/engineer would inspect the pile. The pile inspection consisted of both visual, tactile, and ultrasonic evaluation. Visually each cleaned elevation of each pile was inspected for pits, deformations, holes, and any deterioration or abnormalities. The growth surrounding the cleaned area was inspected and in most cases additional growth scraped off to determine the nature and consistency of biofouling and oxidation. The piles were then measured.

Measurements were primarily conducted using the ultrasonic non-destructive test unit, but included the depth measurements of any pits that were located using a pit gauge or the ultrasonic unit. If it was possible to get the transducer into the pit, holes were also measured using a conventional

steel rule and thicknesses of the flange were measured and verified using a caliper device.

Ultrasonic measurements were taken in the entire cleaned area prior to a specific measurement being taken. This enabled the diver/engineer to have an understanding of the area being measured as well as knowledge of the exact location to be measured in detail. A total of 15 readings were taken at each pile consisting of seven readings just under the pile jacket, four readings at a mid-depth location, and four readings at a mudline location. In each case a series of readings were taken and a mathematical average of the readings computed as the mean thickness value for that specific location. It has been found that this method allows a much more accurate representation of the pile being inspected.

It is interesting to note that most pits had a steel thickness of .25 inches to .35 inches while the area around the pits was usually .42 inches to .47 inches. This was found to be true in most areas with medium or deep pits.

Some abnormal conditions were noted on certain piles in that very large, deep pits were discovered that were very pronounced. These pits were by themselves and went almost completely through the pile. A number of holes were also discovered which had probably originated as one of the deep pits. In most cases these deep pits and holes were located only at the upper elevation directly under the pile jacket, except for one hole located just above the mudline.

Upon completion of the detailed inspection of the 16 piles, photographic documentation and video tape recordings of the inspection techniques as well as conditions encountered were made.

EXISTING PILE JACKETS

There were basically four types of existing pile jackets at Pier Lima. The first was an older-style short jacket consisting of a very coarse concrete, 3 to 4 feet in length with a diameter of 24 inches. The second was the newer-style tall jacket approximately 6 feet long and 28 inches in diameter with a concrete of a very fine texture. The third consisted of jackets primarily located in the outer bents of the pier which had cardboard Sonotube forms still in place which were approximately 6 feet in length containing a concrete with a very coarse aggregate. The fourth type of jackets found were two square jackets of fine grain concrete and two jackets made with 55 gallon drums.

The short, older-style pile jackets ranged in length from 3 feet to 3 1/2 feet long and consisted of a very coarse grain concrete. The diameter of the jackets was found to be 24 inches. The aggregate used in this concrete was varied and might possibly have contained shells. The present condition of these jackets is very deteriorated. The top and bottom sections of these jackets are cracking and spalling at the flange corners due to the corrosive action of the piles. It would appear that the steel piles were not cleaned enough prior to the coal tar epoxy application to seal out the moisture from the piles. Once the moisture had entered, a corroding action began which then cracked the concrete pile jacket. In some cases this forced portions of the jacket off the pile completely. Signs of this type of deterioration were noticed on a majority of the piles as noted in the appendix. It was noted that large amounts of aggregate were exposed in the concrete at the waterline, suggesting either a cold joint or the leaching out of cement from the concrete due to a sulfate attack at one time. It was also noted that there did not appear to be as much exposed aggregate around the other types of jackets. Also, on the shorter-style jackets,

it was noted that the bottoms of the jackets were highly irregular and in many cases sections of the jacket had fallen away with as much as 1 foot of the jacket missing. The taller newer-style jackets were found to be in better condition than the older-style jackets. These jackets had a height of approximately 6 feet with some as long as 8 feet. On the average they had 4 feet above the water surface and 2 feet of it extending below the water surface with a diameter of 28 inches. The concrete in these jackets was a fine grain concrete which appeared in very good condition. Most of these piles had only one or two very small cracks generating from the end of the flange outward in the cylinder to the outer circumference of the pile jacket.

The third type of jacket inspected was the Sonotube-type jackets. These concrete jackets were still encompassed by the fiberboard Sonotube that was used as a form. Inspection of the actual concrete was limited due to this coverage but in many spots where the concrete was available for inspection it was noted that an abundance of large aggregate was present with little concrete showing. If these locations were points that were leaking concrete during construction, this condition would be quite possible. Without knowledge of the concrete used it is difficult to determine the strength of these repairs. The Sonotube jackets were approximately 6 feet to 8 feet long and with the exception of a select few were in good condition. It should be noted that the exceptions in most cases were caused by improper support of the form allowing the form to lose concentricity, allowing it to fall over and completely block concrete from getting into the opposite side. This would not allow adequate cover around the steel H-pile.

The remaining type of jackets found under the pier were square jackets which were both 24 inches square and approximately 6 feet long, consisting of a fine grain concrete which appeared to be in good condition and of good quality. Also two jackets were found formed with 55 gallon drums.

During our inspection of the pile jackets, the amount and type of cracks and spalls were noted and are included in the appendix. In most cases small spalling cracks approximately 1/16" to 1/8" wide had generated from the flange edge radially outward to the outer circumference of the pile jackets. In the worst cases, notably the short older-style jackets this deterioration had progressed enough to allow actual spalling of concrete. This condition was caused due to the improper protection of the upper portion of the steel H-pile as well as a possible improper cleaning of the H-pile inside the concrete jacket, allowing water entry and the corrosive action.

Another fault discovered in the inspection was that of the lack of concentricity of pile jackets. To effectively protect and strengthen the steel H-piles, the pile jacket must remain concentric about the axis of the pile. On many piles this was not the case. When the concrete pile jacket does not have adequate cover over the steel pile, it both reduces the structural strength given to that pile as well as allowing moisture to seep back to the steel pile and allow the corroding process to begin. On many piles inspected rust signs were readily observable. Unfortunately, the GFI could not include all records of the past repairs made to this pier. Therefore, the time frame in which the smaller older-style repairs were made is not known nor is there data on the concrete used for the four types of pile jackets.

Due to the inability to inspect the concrete of those piles that were encased in Sonotubes, structural conclusions are based on small portions of the concrete inspected through occassional opened sections. Further inspection including concrete coring should be conducted on these piles, during the repair phase, to further evaluate these piles.

## UNDERWATER INSPECTION

We feel that the underwater inspection of the 16 piles portrayed a representative sample of the piles under the pier and allowed conclusions to be made on the conditions to be encountered on all piles in general. Several piles were chosen due to the GFI identification as having "DW" or decreased flange width. Both prior to and after cleaning these piles, the corrosion of the flanges was apparent. After the cleaning, the exact extent of the corrosion was determined and noted. Several slides were taken of the conditions encountered at each of the three inspection elevations.

In most cases, the flange deterioration or "necking down" of the flange was found at the upper elevations only. In most cases, this necking down was located within 2 feet of the underside of the pile jacket which would be between 2 feet and 4 feet below the water surface. Loss of section of the flange was contained within a specific zone on each pile. There were no lengthy sections of severe loss. It was found that within a foot of this elevation, the pile flange once again was at original width with a flange thickness at the edge of 1/8" to 3/16".

Conditions encountered at the upper elevation usually consisted of large deep pits with either knife edge flanges or scalloped flange edges. Biofouling was heavy at this elevation although soft and easily removed. Steel oxidation was present under the biofouling in two layers. The outer most layer was removed easily and was gray in color, the final oxidation level was very hard and had to be forcibly removed and being black in color. Pitting at this elevation varied from smooth steel with a few deep pits to a pattern of small and medium pits very close to each other creating a rippled effect.

Conditions encountered at the mid-depth elevation differed from the upper elevations in that no loss of flange section was evident and fewer large pits were encountered. Biofouling

was reduced substantially while the two oxidation levels were basically the same as the upper elevation.

The mudline elevation inspection showed no loss of flange section, very little biofouling, and the oxidation was found to adhere more to the steel pile. Pitting at this elevation usually consisted of a tight pattern of small and medium pits over the entire surface.

The corrosion of steel in sea water has been found to be 0.005" to 0.010" per year, under normal conditions. However, an accelerated, non-uniform type of attack, commonly called pitting can occur. It seems to be generally accepted that weight loss of submerged steel appears to be an increasing function with respect to time. The pitting factor decreases with respect to time, so the longer the exposure, the lower the pitting factor. This pitting factor can double or triple the weight loss in a specific area over a period of ten years. Due to the limited area of severe pitting, effects of pitting in a structural analysis of submerged steel piles is difficult. An over-all knowledge of the extent of pitting and location of most severe pitting is required, and even then, conclusions remain only estimates. (Ref. Hosford)

At Pier Lima the average rate of section loss was 0.185 square inches per year at the elevation below the present concrete jackets. This is drawn from an average remaining cross-sectional area of 16.1 square inches (or 75 percent of original) after 29 years of exposure. It should be noted again that the rate of corrosion has been increasing with time and will continue to increase. These above mentioned sections do not, however, include the pitting factor which would further decrease the remaining section by as much as 15 percent. Due to the random locations of pits their effects can be factored in directly, but must be considered in the final analysis.

## PILE-PILE CAP CONNECTIONS

During our inspection it was noted that several piles were not carrying any load and that several piles were not connected to the pile cap. In the case of piles not carrying any load, gaps ranged from mere fractions to as much as 3/4 of an inch. Some of these piles were held in position by bolts or lag screws while others were free to move and were observed doing so with the wave action. In some cases the pile plate was noticeably unparalled to the pile cap. In the cases where only partial bearing was achieved, the transfer of load from the deck to the pile when a live load was applied would be questionable. Upon loading, the combination of angled pile plate and partial bearing would cause the pile to displace sideways out from under the pile cap.
Fasteners used in securing the pile plates to the pile cap varied considerably from spikes to bolts to lag screws to sections of rebar. In many cases bolts were present but loose. When transferring a lateral load such as ship impact, these loose bolts rather than acting in sheer, would act in tension and would allow failure of the fastener. In some cases, fasteners were only an inch or two from the outer face of the pile cap which would allow the failure of the timber prior to estimated yield. The bearing area of many of the piles were found to be less than 50 percent. In these cases, although a portion of the pile plate was in direct contact and secured to the pile cap, the central axis of the H-pile did not go through the pile cap. Depending on loads exerted to the pier, this circumstance could greatly reduce the actual capacity allowable for these piles.

## FENDER SYSTEM

An inspection of the fender system on Pier Lima showed that all piles were suffering from Limnoria attack and had a reduced cross section at the waterline of at least 50 percent. Many piles were broken at the waterline and some piles only existed from the mudline to the water surface, with the top portion missing. Some brand new piles were in position on the northeast end of the pier.

Due to the apparent heavy Limnoria infestation and the requirement of adequate fenders, the fender system must be rebuilt and/or redesigned. While conducting our survey two fender piles, one old and one new, were broken in half during berthing operations. If the timber fenders are ineffective, loads will be taken by the pier structure directly. One concrete-jacketed H-pile was found to have been displaced due to an impact and paint chips were still on the concrete jacket.

## BATTER PILES

The batter piles were found to be in poor condition. Many batter piles had splices installed at the same elevation of the top level of the concrete jackets which created a very weak structural situation. The splices consisted of two plates bolted to opposite flanges, which resulted in the cross sectional area and strength of the pile being weakest at this location. Also noted was that only a few batter piles had adequate concrete coverage over the H-piles. In most cases, the steel was covered by one inch or less of concrete. The necessity of installing splices on these batter piles reflects that problems were encountered at one time with the structural strength of these piles. Unfortunately, the repairs made to these piles did not adequately protect and strengthen the weak areas. The installation of additional batter piles appears necessary although replacement of all batter piles is not called for.

ASSESSMENT OF STRUCTURAL INTEGRITY

It is the opinion of this firm and its principals that Pier Lima, at Guantanamo Bay, Cuba, should be immediately downrated and ship activity restricted. We feel that the data developed herein supports this decision and explains the necessities for this recommended action. Several factors were considered in the structural assessment. The average minimum cross sectional area of piles was determined to be 78 percent, resulting in the average pile capacity being reduced to 52 percent. This value could be further reduced by as much as 15 percent on specific piles that have holes and severe deep pitting at the elevation under the concrete jacket. This "pitting factor" was also considered as an additional variable in the assessment. (Ref. Rogers)

The majority of the piles have the small older-style jackets which are of questionable benefit. These jackets appear to have temporarily restricted the corrosion of the piles they encase, but not protect or fully strengthen them. The spalling of these jackets, both topside and underwater, demonstrates that this repair was improperly designed and constructed. The length of the jackets is inadequate to encompass the normal zone of deterioration which is evident by the flange width loss directly below these jackets.

The connections between the pile plates and the pile caps were also inspected and factored into the assessment. There exists over 150 piles which require new bolts and installations, over 60 piles which need realignment, and at least 12 piles that require shimming to properly transfer any pier load. At least 5 sections of pile cap were deteriorated enough to necessitate replacement or reinforcing. These conditions, taken by themselves are not as critical. Coupled with the pile deterioration and lack of functional fender system they become significant.

The existence of holes through the flanges and webs in the existing H-piles, combined with the existence of large, deep pits in the H-piles prompted careful study of the piles to determine their structural strength and repairability. This deterioration was primarily located in the area directly beneath the smaller older-style jackets, which constituted the weakest area of the piles. However, due to the localized nature of the severe deterioration, the piles are repairable. Calculations of pile capacity yielded values of 38 to 57 percent of their original capacities, or maximum loads of 48 to 119 kips. As mentioned earlier, heavy pitting, flange corrosion, and the existence of holes could lower these values an additional 15 percent.

The batter piles, as they presently exist, offer a fraction of their original capacity due to the method of splicing and jacketing. The jackets, while covering what is suspected to be the area of worst deterioration, does not consist of a proper structural repair due to the absence of adequate concrete cover over existing steel. This fact combined with the splice locations above the jacket, makes this the weakest point in the pile. Under a load,the two parallel plates would not offer proper restraint and a deformation of the plates would occur and indeed has occured in at least two piles. Rather than replace all batter piles we suggest replacing strategically located batter piles, so positioned to provide proper lateral restraint to the pier where the lateral loads would occur during a berthing operation and under wind loads.

Due to these conditions we suggest a temporary downrating of Pier Lima to 250 pounds per square foot. The derivation of this value is outlined in Appendix I. This rating should remain in effect until the suggested repairs are made and further evaluation and rating of the Sonotube encased piles has been completed.

Although the scope of work has not included a complete pier system structural analysis, some general conclusions can be drawn from the site conditions coupled with the calculations presented. Continued berthing activity without an adequate fender system will allow all vessel impacts to be directly transferred to the steel piles. In their present condition, pile failure is quite possible during a heavy lateral impact load.

Prior to the installation of a new fender system caution should be exercised in all berthing operations so as not to allow any significant impact load. The effectiveness of the present fender design should be re-evaluated with respect to both cost and effective life prior to timber piles being replaced.

We suggest restricting berthing activities until a new fender system has been installed. Restrictions should include additional caution exercised in berthing operations and all vessels should be tug-assisted. Tugs should avoid any contact with the timber fender piles if possible. During undocking operations two fender piles were sheared in half due to the force a tugboat exerted on it. Extra caution should be taken when winds are over 15 knots when any vessel is being berthed.

## ASSESSMENT OF REPAIRABILITY

1. PILE JACKETS All of the small older-style jackets should be removed and replaced. In most cases these jackets are presently cracked in the area of each flange, making removal not difficult. Due to the uncertain concrete strength, numerous cracks and spalling occur both above and below the waterline, so the jackets do not effectively add strength to the piles. If these jackets were left on, they would continue to deteriorate and offer less and less structural strength.

   The pile jackets that replace these should be longer jackets, approximately 8 feet long, to encompass all of the heavy deterioration of the piles. These jackets should contain a reinforcing bar cage as shown in the attached engineering drawing and should be of proper 5000 psi concrete. After installation of the pile jacket, the exposed steel pile between the pile cap and the new pile jacket should be sandblasted to commercial finish and a coal tar epoxy applied.

   An alternate method of repair would involve bolting two sections of MC 10 x 28.5 steel into the webs of the corroded steel H-piles. Each pair of channels would be bolted in place with ten (10) stainless steel bolts of 7/8 inch diameter. This method of repair is represented in Figure 2.

   Due to the necessity of thorough cleaning of the steel piles and the thinness of the pile in the area to be repaired, this method, although an acknowledged repair method, is not recommended. Furthermore, the extent of corrosion of the steel at this location leads us to recommend concrete as an appropriate repair material over steel.

2. PILE CAP CONNECTION The repairs necessary to bring the pile-pile cap connections to their original design

capabilities include:

(a) New bolt installations. Presently spikes and lengths of rebar are securing the piles and these should be replaced with proper lag screws or bolts, where applicable, to securely fasten the piles to the pile caps. As mentioned before there are approximately 150 piles requiring this repair.

(b) Shimming of the piles. The shimming of piles that are presently not carrying a load is required. Due to the present configuration this would best be achieved by jacking up the cap in that location and installing spacers or shims. There are approximately 12 piles that require this repair.

(c) Repositioning piles. There are approximately 60 piles that presently do not properly line up with the pile cap. These piles must either be forcibly repositioned after bolts through the pile cap have been removed, or if necessary larger pile plate installed and additional timber pile cap pieces installed to allow the pile to bear more effectively on the pile cap system.

(d) Repairs to the deteriorated pile caps. There are at least five pile cap sections which are deteriorated enough to allow possible failure of the pile cap. Repair of these timbers could be accomplished either by removing a section, replacing it, and securing this new section to the existing timber pile cap splicing the two together with a splice plate and bolts. An alternate would be to form around the existing timber and inject an epoxy resin/furgicide that would not only strengthen the piece but also halt any further rot or decay. The locations for this work are at the ends of the pile caps offering good accessibility.

3. <u>FENDER SYSTEM</u> The fender system as it exists now is ineffective. As mentioned before, either a timber fender system or a rubber, marine fender system should be installed to absorb any lateral loads such as ship impact or wind loads.

If a timber fender system is to be reinstalled, protection of the piles from Limnoria attack is desirable. Various manufacturers of heavy plastic wrap such as Pile Guard or Zippertubing have systems which cause stagnant water to be trapped around the timber thereby destroying worms attempting to attack the timber. Although this plastic wrap cannot withstand ship abrasions, we feel that an adequate protection system of walers would be adequate to protect the plastic wrap from damage.

An alternate fender system would consist of Lord/ Bridgestone-type marine fender which would not require any timber fender piles but would rely on the compressive nature of the rubber fenders and the pier structure itself for absorbing any impact.

After the recommended repairs have been completed the pier, with the exception of those piles with the Sonotube forms still in place, would achieve 100 percent of its design capacities. As stated before, those piles with Sonotube forms require further analysis in the form of concrete cores taken of a representative sample of piles. Depending on those results, the pier would be rated at its full design capacity.

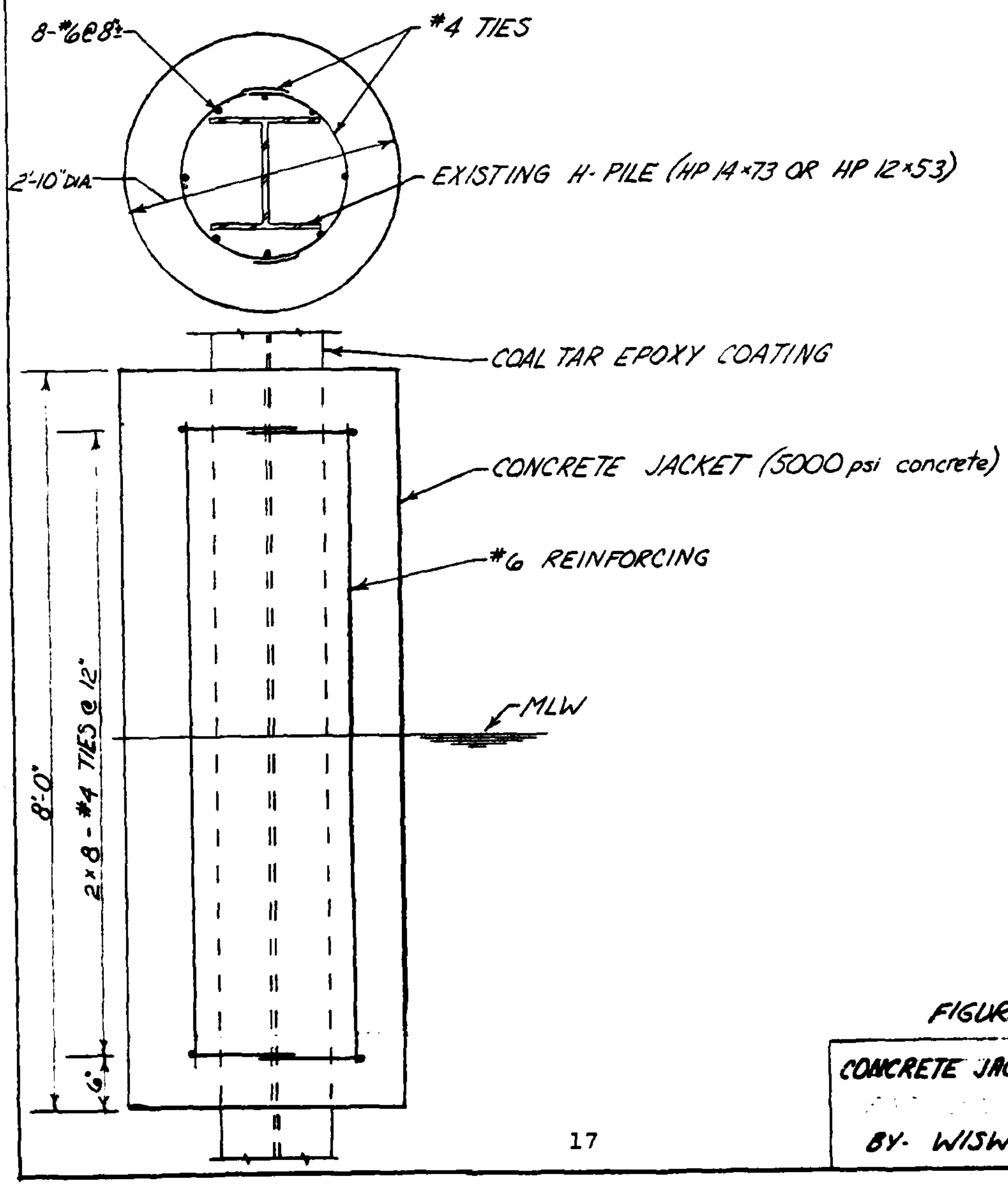



FIGURE 1

CONCRETE JACKET DESIGN

BY- WISWELL, INC.

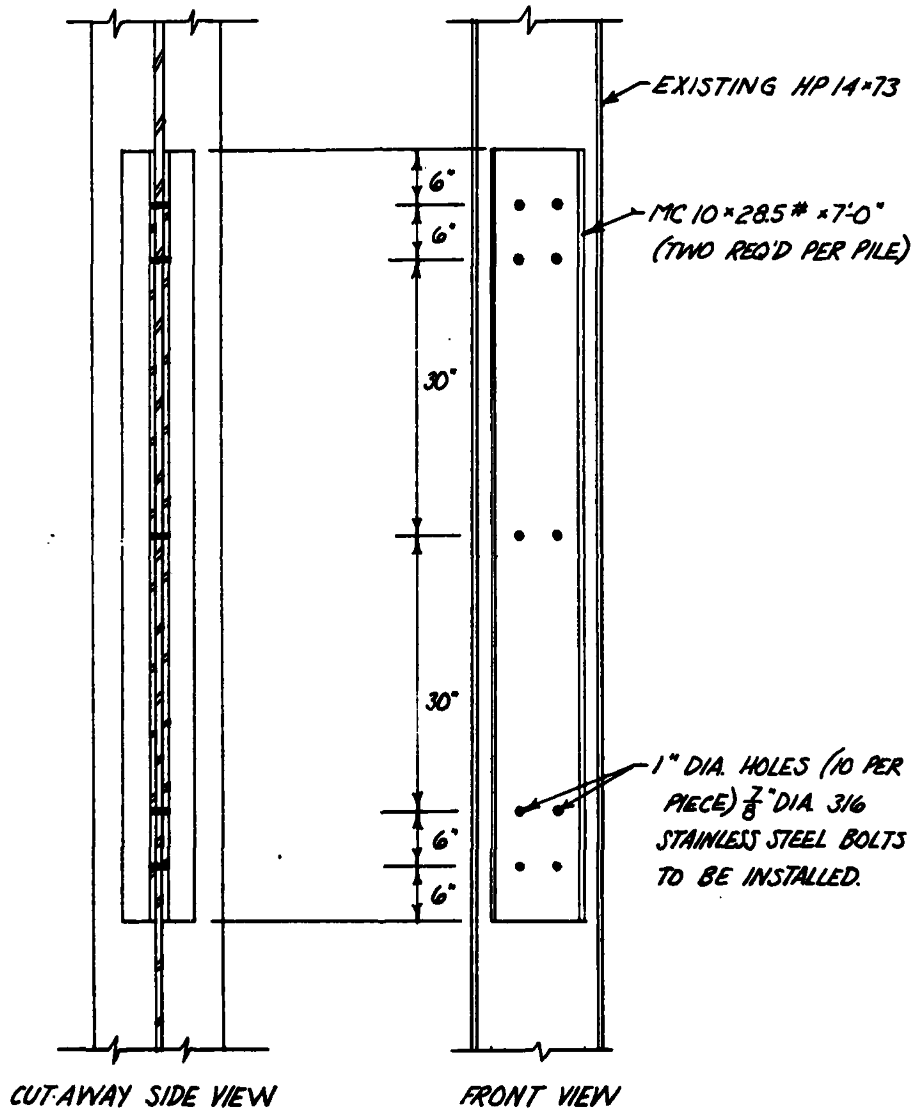



FIGURE 2
ALTERNATE PILE REPAIR

BY WISWELL INC

## COST AND TIME ESTIMATE

Estimates for both cost and time required to complete the repairs have been computed for the above recommended repairs. Due to the geographical location and associated logistics problems of transporting men, equipment, and necessary supplies, estimates are based on men and equipment departing from Norfolk, Virginia on government-provided transportation. The repairs to each pile consisting of removal of the old jacket, cleaning of the piles, installing the reinforcing cage, forming the pile, pumping it with a high strength concrete and application of the coal tar epoxy is estimated to be $1,158.30 per pile. This price consists of:

| | |
|---|---|
| Concrete Forms | $ 140.00 |
| Hydro-Laser for cleaning | 60.00 |
| Misc. material & equipment | 90.00 |
| Labor, overhead & profit | 868.30 |
| | $1,158.30 |

Based on 518 piles to be jacketed, the total for this repair would be $600,000. We recommend the jacketing of a minimum of 335 piles with an option for more piles to be jacketed, as individually inspected. The minimum cost would be $388,030.50, based on the $1,158.30 per pile. These price estimates are realistic and competitive and in our opinion, the lowest responsible bid would be very close to this figure. The length of time required to complete this repair would be approximately six to eight months.

The repairs to the pile-pile cap connections include the new bolt installations, the shimming of the piles not presently carrying a load, jacking piles into alignment, and the repair of deteriorated pile caps. This work has been estimated at a cost of $200,000 and would require two months to complete. An estimate for the fender system was difficult to compile due to transportation, etc., of the materials, equipment, etc. It was noticed, however, that a large supply of treated timber piles were present at the base. We feel that a Naval

operation of replacing the timber piles would be more cost effective than an outside contractor doing this work. The cost for wrapping the timber piles is estimated at $250 per pile. This wrapping would have to be conducted prior to installation of the waler protection system. The cost for the Lord/Bridgestone marine fender system is estimated at $200,000.

The estimate assumes concrete to be supplied, without cost, by the U.S. Navy batching plant located on the Naval Station. Additionally, housing is to be supplied, without cost, by the U.S. Navy at the Naval Station.

These repairs should extend the useful life of Pier Lima an additional 15 to 20 years, with 100 percent of its original capacity. The 100 percent capacity is contingent on the further inspection of the jackets with forms remaining, which could be easily factored into the repair contract.

## GENERAL SITE CONDITIONS

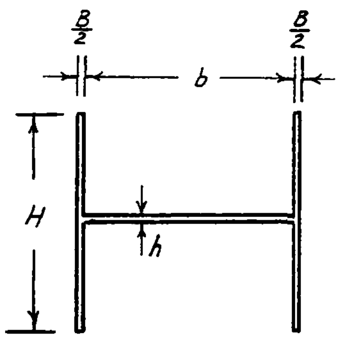
During the inspection it was noted that the tidal flux was minimal, averaging less than a foot. In discussion with personnel at the site, it was determined that the prevailing wind was from the northwest which would be coming off the shore in the area of Pier Lima.

It was also determined that the location of Pier Lima relative to the harbor entrance made it a very busy pier as far as ship activities were concerned.

Pier Lima was originally constructed as a timber pier with a dry dock on the west side. The older timber piles were replaced by steel piles in the size of BP 12x53 and BP 14x73 in the early 1950's. 232 of these piles were then jacketed to some extent in the early 1970's. These jackets are referred to in the text as the long, newer-style jackets. No data was available on the dates or details of the jackets on the remaining piles, which were protected with three different types of jackets. The specifications for the early 1970's repairs call for four types of jackets to be used, depending on the deterioration. Reference is made to holes in piles, flanges missing and remaining areas of less than 50 percent. Some 135 piles required the more extensive repairs.

We must assume that in view of the generally poor condition of some of these jackets that this deterioration has continued and is now more severe than at that time.

PILE DATA BACKGROUND




$$I = \frac{BH^3 + bh^3}{12}$$

$$S = \frac{I}{C} = \frac{BH^3 + bh^3}{6H}$$

$$r = \sqrt{\frac{BH^3 + bh^3}{12\ (BH + bh)}}$$

$$A = BH + bh$$

K = 1.0, assuming top of pile not fixed or braced.

l = h = 10' + (mudline to waterline) + (waterline to cap)

To calculate the moment of inertia, section modulus, and radius of gyration for the piles inspected in detail, certain assumptions had to be made. The average flange thickness was taken as the mathematical average of the values taken at each elevation. The web thickness was taken as the mathematical average of the web thickness readings at each elevation.

The flange width offered a problem in that the knife edge shape of the flange as it approached the end made it difficult to get a realistic width measurement. In many cases, there was a scalloped effect where it was readily ascertainable that the width was decreased. In each case where the scalloping occurred the flange width approximated 12.5 inches. These cases were only found at the upper elevation, beneath the pile jacket.

In those cases where a knife edge was still present the flange width was slightly more but due to the extreme thinness of the flange, we have opted to assume a flange width of 12.5 inches for all readings taken just below the underside of the jacket.

For readings taken at mid-depth and at mudline there was no loss of steel at the flange edges and the knife edge effect

was much less pronounced, therefore, a flange width of 14.5 inches was used.

APPENDIX I

PIER LIMA
NAVAL STATION, GUANTANAMO BAY, CUBA

PILE CAPACITY DATA & CALCULATIONS

PILE CAPACITY DATA

PIER LIMA
GUANTANAMO BAY, CUBA

| PILE/LOCATION | | $A_2$ (in.$^2$) | $\frac{A_1}{A_0}$ (%) | $\frac{Kl}{r}$ | $F_a$ (kips) | P (kips) | $P_0$ (kips) | $\frac{P}{P_0}$ (%) |
|---|---|---|---|---|---|---|---|---|
| 14G | UJ | 14.44 | 67.3 | 134.3 | 8.23 | 119.0 | 240. | 49.6 |
| | - 8' | 16.10 | 75.0 | | | | | |
| | -16' | 17.82 | 83.0 | | | | | |
| 15F | UJ | 15.22 | 70.9 | 150.0 | 6.64 | 101.0 | 220. | 45.9 |
| | - 8' | 18.37 | 85.6 | | | | | |
| | -18' | 19.22 | 89.6 | | | | | |
| 15G | UJ | 16.25 | 75.7 | 169.1 | 5.22 | 80.5 | 153. | 52.6 |
| | -15' | 15.42 | 71.8 | | | | | |
| | -25' | 18.26 | 85.1 | | | | | |
| 16G | UJ | 16.38 | 78.3 | 169.1 | 5.22 | 80.5 | 153. | 52.6 |
| | -15' | 18.02 | 84.0 | | | | | |
| | -25' | 17.90 | 83.4 | | | | | |
| 37E | UJ | 17.27 | 80.5 | 193.2 | 4.00 | 65.8 | 123. | 53.5 |
| | -19' | 18.54 | 86.4 | | | | | |
| | -30' | 16.46 | 76.7 | | | | | |
| 37F | UJ | 16.70 | 77.8 | 193.8 | 3.98 | 66.5 | 123. | 54.0 |
| | -17' | 18.69 | 87.1 | | | | | |
| | -30' | 17.00 | 79.2 | | | | | |
| 37G | UJ | 15.56 | 72.5 | 215.9 | 3.10* | 48.2* | 100. | 48.2* |
| | -20' | 16.52 | 77.0 | | | | | |
| | -35' | 18.73 | 87.3 | | | | | |
| 40A | UJ | 16.20 | 75.5 | 195.1 | 3.93 | 63.7 | 123. | 51.8 |
| | -18' | 17.80 | 82.9 | | | | | |
| | -30' | 18.53 | 86.3 | | | | | |
| 40B | UJ | 15.00 | 69.9 | 187.8 | 4.24 | 63.6 | 128. | 49.7 |
| | -18' | 19.21 | 89.5 | | | | | |
| | -29' | 16.40 | 76.4 | | | | | |
| 40C | UJ | 14.31 | 66.6 | 192.9 | 4.01 | 51.0 | 134. | 38.1 |
| | -19' | 12.72 | 59.3 | | | | | |
| | -28' | 18.14 | 84.5 | | | | | |
| 40D | UJ | 16.77 | 78.1 | 181.2 | 4.55 | 76.3 | 134. | 56.9 |
| | -19' | 18.07 | 84.2 | | | | | |
| | -28' | 18.86 | 87.9 | | | | | |

## PILE CAPACITY DATA
(page 2)

| PILE/LOCATION | | $A_1$ (in.$^2$) | $\frac{A_1}{A_o}$ (%) | $\frac{Kl}{r}$ | $F_a$ (ksi) | P (kips) | $P_o$ (kips) | $\frac{P}{P_o}$ (%) |
|---|---|---|---|---|---|---|---|---|
| 40E | UJ | 16.54 | 77.1 | 195.8 | 3.90 | 64.5 | 123. | 52.4 |
| | -20' | 18.34 | 85.5 | | | | | |
| | -30' | 17.12 | 79.8 | | | | | |
| 40F | UJ | 15.71 | 73.2 | 201.3 | 3.70* | 58.3* | 108. | 54.0* |
| | -21' | 18.85 | 87.8 | | | | | |
| | -33' | 19.51 | 90.9 | | | | | |
| 40G | UJ | 17.74 | 82.7 | 201.3 | 3.70* | 61.5* | 108. | 57.0* |
| | -20' | 16.62 | 77.4 | | | | | |
| | -33' | 19.74 | 92.0 | | | | | |
| 79F | UJ | 16.60 | 77.4 | 198.6 | 3.79 | 62.9 | 118. | 53.3 |
| | -15' | 16.83 | 78.4 | | | | | |
| | -31' | 16.64 | 77.4 | | | | | |
| 79G | UJ | 16.08 | 74.9 | 210.8 | 3.40* | 54.7* | 100. | 54.7* |
| | -17' | 17.54 | 81.7 | | | | | |
| | -35' | 17.87 | 83.3 | | | | | |

*Due to value of $\frac{Kl}{r}$ exceeding 200, extrapolation necessary to determine allowable stress.

KEY:

$A_1$ = Cross sectional area

$A_o$ = Original cross sectional area

$F_a$ = Allowable stress

P = Pile capacity (kips)

$P_o$ = Original pile capacity (kips)

$\frac{Kl}{r}$ = Effective slenderness ratio

Note: Factor of Safety = 1.67

Note: Pile is non-compact

## PILE DATA

### PIER LIMA
### GUANTANAMO BAY, CUBA

| Pile/Location | | A (in.) | B (in.) | C (in.) | I (in.$^4$) | S (in.$^3$) | r (in.) |
|---|---|---|---|---|---|---|---|
| 14G | UJ | .363 | .426 | 12.5 | 118.0 | 18.9 | 2.86 |
| | - 8' | .371 | .424 | 14.5 | 188.6 | 26.0 | 3.42 |
| | -16' | .423 | .441 | 14.5 | 215.0 | 29.6 | 3.47 |
| 15F | UJ | .368 | .478 | 12.5 | 120.0 | 19.2 | 2.80 |
| | - 8' | .445 | .434 | 14.5 | 226.2 | 31.2 | 3.51 |
| | -18' | .481 | .418 | 14.5 | 244.5 | 33.7 | 3.57 |
| 15G | UJ | .443 | .411 | 12.5 | 144.3 | 23.1 | 2.98 |
| | -15' | .353 | .411 | 14.5 | 179.4 | 24.7 | 3.41 |
| | -25' | .449 | .416 | 14.5 | 228.2 | 31.5 | 3.53 |
| 16G | UJ | .447 | .413 | 12.5 | 145.6 | 23.3 | 2.98 |
| | -15' | .457 | .378 | 14.5 | 232.2 | 32.0 | 3.59 |
| | -25' | .444 | .399 | 14.5 | 225.6 | 31.1 | 3.55 |
| 37E | UJ | .453 | .472 | 12.5 | 147.6 | 23.6 | 2.92 |
| | -19' | .443 | .452 | 14.5 | 225.2 | 31.1 | 3.48 |
| | -30' | .375 | .443 | 14.5 | 190.6 | 26.3 | 3.40 |
| 37F | UJ | .433 | .466 | 12.5 | 141.0 | 22.6 | 2.91 |
| | -17' | .433 | .487 | 14.5 | 220.1 | 30.4 | 3.43 |
| | -30' | .399 | .431 | 14.5 | 202.8 | 28.0 | 3.45 |
| 37G | UJ | .400 | .441 | 12.5 | 130.3 | 20.8 | 2.89 |
| | -20' | .407 | .374 | 14.5 | 206.8 | 28.5 | 3.54 |
| | -35' | .476 | .391 | 14.5 | 242.0 | 33.4 | 3.59 |
| 40A | UJ | .415 | .462 | 12.5 | 135.2 | 21.6 | 2.89 |
| | -18' | .454 | .368 | 14.5 | 230.7 | 31.8 | 3.60 |
| | -30' | .442 | .453 | 14.5 | 224.7 | 31.0 | 3.48 |
| 40B | UJ | .398 | .401 | 12.5 | 129.6 | 20.7 | 2.94 |
| | -18' | .469 | .445 | 14.5 | 238.4 | 32.9 | 3.52 |
| | -29' | .371 | .448 | 14.5 | 188.6 | 26.0 | 3.39 |
| 40C | UJ | .345 | .451 | 12.5 | 112.4 | 18.0 | 2.80 |
| | -19' | .256 | .420 | 14.5 | 130.1 | 17.9 | 3.20 |
| | -28' | .450 | .404 | 14.5 | 228.7 | 31.5 | 3.55 |
| 40D | UJ | .457 | .424 | 12.5 | 148.8 | 23.8 | 2.98 |
| | -19' | .437 | .428 | 14.5 | 222.1 | 30.6 | 3.50 |
| | -28' | .464 | .429 | 14.5 | 235.8 | 32.5 | 3.54 |
| 40E | UJ | .421 | .477 | 12.5 | 137.1 | 21.9 | 2.88 |
| | -20' | .447 | .427 | 14.5 | 227.2 | 31.3 | 3.52 |
| | -30' | .420 | .392 | 14.5 | 213.5 | 29.4 | 3.53 |
| 40F | UJ | .431 | .392 | 12.5 | 140.4 | 22.5 | 2.98 |
| | -21' | .454 | .451 | 14.5 | 230.8 | 31.8 | 3.50 |
| | -33' | .465 | .478 | 14.5 | 236.4 | 32.6 | 3.48 |

PILE DATA
(page 2)

| Pile/Location | | A (in.) | B (in.) | C (in.) | I (in.$^4$) | S (in.$^3$) | r (in.) |
|---|---|---|---|---|---|---|---|
| 40G | UJ | .485 | .446 | 12.5 | 158.0 | 25.3 | 2.98 |
| | -20' | .395 | .410 | 14.5 | 200.8 | 27.7 | 3.47 |
| | -33' | .481 | .460 | 14.5 | 244.5 | 33.7 | 3.52 |
| 79F | UJ | .430 | .464 | 12.5 | 140.1 | 22.4 | 2.90 |
| | -15' | .390 | .438 | 14.5 | 198.2 | 27.3 | 3.45 |
| | -31' | .411 | .375 | 14.5 | 208.9 | 28.8 | 3.54 |
| 79G | UJ | .433 | .417 | 12.5 | 141.0 | 22.6 | 2.96 |
| | -17' | .422 | .421 | 14.5 | 214.5 | 29.6 | 3.51 |
| | -35' | .422 | .447 | 14.5 | 214.5 | 29.6 | 3.46 |

KEY:

A = Mean Flange Thickness

B = Mean Web Thickness

C = Flange Width

I = Moment of Inertia

S = Section Modulus

r = Radius of Gyration

# DEAD LOAD CALCULATIONS

Pier - 60' x 648' = 38,880 sq. ft.

Reinforced concrete with aggregate @ 150#/cu. ft.

Long Leaf Yellow Pine @ 44#/cu. ft.

Old Concrete Deck 8" thick = 25,920 cu. ft. = 3,888 kips

New Concrete Deck 8 1/2" thick = 27,540 cu. ft. = 4,131 kips

Concrete Curb 30" x 10" x 525' = 1,093.75 cu. ft. = 164 kips

Concrete Skirt 12" x 24" x 555' = 1,110 cu. ft. = 166.5 kips

Combined Deck = 8,349.5 kips

Pile Caps - composite made up of 6" x 12" and 12" x 12"<br>
plus 6" x 16" and 14" x 16"<br>
18" x 12" = 1.5 sq. ft.<br>
20" x 16" = 2.22 sq. ft.<br>
3.72 sq. ft.<br>
x 60' = 223.2 cu. ft./bent x 44#/cu. ft. = 9,820.2#/bent<br>
x 80 bents = 785,664# = 785.7 kips

Recap:

8,349.5<br>
+ 785.7<br>
9,135.2 kips ÷ 81 bents (including #1 (shore))=112.8 kips/bent<br>
÷ 7 piles/bent (unweighted re spacing) = 16.11 kips/pile

Spacing between pile rows as follows:

| | |
|---|---|
| A to B 12.5' | D to E 9.5' |
| B to C 9' | E to F 8.5' |
| C to D 8.5' | F to G 8.25' |

This spacing arrangement yields the following loading:

| ROW | LOAD PER ROW (kips) | LOAD PER PILE IN THE ROW (kips) |
|---|---|---|
| A | 1,256 | 15.4 |
| B | 1,636 | 20.2 |
| C | 1,332 | 16.4 |
| D | 1,370 | 17.0 |
| E | 1,372 | 17.0 |
| F | 1,256 | 15.6 |
| G | 912 | 11.2 |

*Assumes combined dead load of 9,136 kips

## LIVE LOAD CALCULATIONS

| PILE/LOCATION | P (kips) | $P_1$ (kips) | D (kips) | L (kips) |
|---|---|---|---|---|
| 14G | 119.0 | 72.3 | 11.2 | 61.1 |
| 15F | 101.0 | 61.3 | 15.6 | 45.7 |
| 15G | 80.5 | 48.9 | 11.2 | 37.7 |
| 16G | 80.5 | 48.9 | 11.2 | 37.7 |
| 37E | 65.8 | 40.0 | 17.0 | 23.0 |
| 37F | 66.5 | 40.4 | 15.6 | 24.8 |
| 37G | 48.2 | 29.3 | 11.2 | 18.1 |
| 40A | 63.7 | 38.7 | 15.4 | 23.3 |
| 40B | 63.6 | 38.6 | 20.2 | 18.4 |
| 40C | 51.0 | 31.0 | 16.4 | 14.6 |
| 40D | 76.3 | 46.3 | 17.0 | 29.3 |
| 40E | 64.5 | 39.2 | 17.0 | 22.2 |
| 40F | 58.3 | 35.4 | 15.6 | 19.8 |
| 40G | 61.5 | 37.3 | 11.2 | 26.1 |
| 79F | 62.9 | 38.2 | 15.6 | 22.6 |
| 79G | 54.7 | 33.2 | 11.2 | 22.0 |

Key:

P = pile capacity (safety factor = 1.67)

$P_1$ = pile capacity (safety factor = 2.75)

L = live load capacity (safety factor = 2.75)

D = dead load for that pile, in that bent

Pier - 60' x 648' = 38,880 sq. ft.

Pier area per pile = $\frac{38{,}880 \text{ sq. ft}}{81 \times 7}$ = 68.57 sq. ft

Live Load Capacity(L) = Pile Capacity(P or $P_1$) - Dead Load(D)

Minimum value for live load = 14.6 kips on Pile 40C

Live Load = $\frac{14.6 \text{ kips/pile}}{68.57 \text{ sq ft/pile}}$ = 213 p.s.f.

The recommended live load capacity is 250 pounds per square foot. This value allows a safety factor of more than 2.5, without greatly restricting pier operations. In our judgment and based on the pile capacity calculations, downrating the pier to 250 p.s.f. is a safe operating load.

APPENDIX II

PIER LIMA
NAVAL STATION, GUANTANAMO BAY, CUBA

PILE INSPECTION DATA
BENTS #2 THRU #50

| PILE # | | BOLTS | BEARING AREA | JACKET | CRACKS | SPALLS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 2 | A | | G | | | | |
| | B | | G | O | | | DC, ER |
| | C | | G | | | | |
| | D | | G | | | | |
| | E | 2 | G | | | | NJ |
| | F | | G | | | | |
| | G | | G | | | | |
| | BP | | | | | | |
| 3 | A | 2 | G | O | | | |
| | B | 2 | G | N | | | * |
| | C | 2 | G | O | | | |
| | D | 2 | G | O | | | |
| | E | 2 | G | | | | 55 gallon drum |
| | F | 2 | G | | | | |
| | G | 2 | G | | | | 55 gallon drum |
| | BP | | | | | | |
| 4 | A | | | | | | |
| | B | | | | | | |
| | C | | | | | | |
| | D | | | | | | |
| | E | | | | | | |
| | F | | | | | | |
| | G | | | | | | |
| | BP | | | | | | |
| 5 | A | | | N-4 | 1H | | |
| | B | 1 | | N-4 | 3H | | |
| | C | | | O-2 | 3S | | |
| | D | | | O-2 | | 1MS | |
| | E | | | O-2 | | | |
| | F | | | O-2 | | | |
| | G | | | O-2 | 1S | | |
| | BP | | | | | | **, NJ |
| 6 | A | | | N-4 | 1H | | |
| | B | 1 | | N-4 | 1H | | GC |
| | C | | | O-2 | 2S | | |
| | D | | | O-2 | 2S | | |
| | E | 2 | | O-2 | | | |
| | F | 2 | | O-2 | 1S | | |
| | G | 2 | | O-2 | 3S | | |
| | BP | | | | | | |
| 7 | A | | | N | | | A, PP |
| | B | | | O | 4S, 1h | 1SS | A |
| | C | | | Sq | | | *** |
| | D | | | | | 2MS | DC, ER, BS |
| | E | 2 | | O | - | | |
| | F | 2 | | O | - | | |
| | G | | | | | | |
| | BP | | | | | | |

*Appears to have buckled and failed.
**Cut off one foot above waterline.
***Note--electrical vault located between 7C and 7D.

| PILE # | | BOLTS | BEARING AREA | JACKET | CRACKS | SPALLS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 8 | A | 2 | | N | 2S | | A* |
| | B | 2 | | O | 3S | | A |
| | C | 2 | | Sq | | | |
| | D | 2 | | | | 1MS | |
| | E | 2 | | | 2S | | |
| | F | 2 | | | 3S | | |
| | G | 2 | | | 2S | | |
| | BP | | | | | | ** |
| 9 | A | 2 | | N | 1H | | |
| | B | 2 | | N | 2S | | V |
| | C | 2 | | O | 2S | | |
| | D | 2 | | O | - | | DC |
| | E | 2 | | O | 2S | | |
| | F | 2 | | O | 3S | | |
| | G | 2 | | O | 3S | | |
| | BP | | | | | | ** |
| 10 | A | 2 | | N | 2S | | |
| | B | 2 | | N | 1S | | A, DC |
| | C | 2 | | O | 1H | | DC |
| | D | 2 | | O | 1S, 1H | | |
| | E | 2 | | O | 4S | | |
| | F | | | | | | |
| | G | | | | | | |
| | BP | | | | | | |
| 11 | A | 1 | | N | 1S | | |
| | B | 2 | | N | 1S | | GC |
| | C | | | O-1 | | 1SS | A |
| | D | 2 | | O | 1S | | |
| | E | 2 | | O | 2S | | |
| | F | 2 | | O | - | | |
| | G | 2 | | O | | | |
| | BP | | | | | | ** |
| 12 | A | 1 | | | 1H | | |
| | B | 1 | 50 | | 1S | | PC |
| | C | | | | 3S | | |
| | D | 2 | | O | 5S | | |
| | E | 2 | | | 3S | | |
| | F | | | | | | V |
| | G | | | | | | GC |
| | BP | | | | | | |
| 13 | A | 2 | | | 3S | | |
| | B | | | | | | |
| | C | 2 | | | 1S | | |
| | D | | | | 3S | | HC |
| | E | 2 | | O | | | GC |
| | F | 2 | | O | 1S | | |
| | G | 2 | | O | | 1SS | |
| | BP | | | | | | |

*Note--between Bent #6 and #8 there are 4 plumb piles and 4 batter piles, old-type repairs, on westside of pier.
**Batter pile cut off one foot above waterline.

| PILE # | | BOLTS | BEARING AREA | JACKET | CRACKS | SPALLS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 14 | A | 2 | | | 3S | 1SS | ER |
| | B | 2 | | | 4H | | |
| | C | 2 | | O | 1S | | DC, HC |
| | D | 2 | | O | 3S | | PC |
| | E | 2 | | O | - | | |
| | F | 2 | | O | - | | A |
| | G | 2 | | O | - | | |
| | BP | | | | | | |
| 15 | A | 2 | | N | 1H | | PP |
| | B | | | | 3S | | RS |
| | C | 2 | | | 1S | | RS, A, HC |
| | D | | | | 1S | | DC |
| | E | 2 | | | 2S | | |
| | F | 2 | | | - | | |
| | G | 2 | | | - | | |
| | BP | | | | | | |
| 16 | A | R | | | 3S | | DC |
| | B | 2 | | | 3S | | |
| | C | 2 | | | 1H | | |
| | D | | | | 3S | | |
| | E | 2 | | | | | |
| | F | 2 | | | 2S | | |
| | G | | | | | | |
| | BP | | | | | | |
| 17 | A | 2 | G | N-3 | 3S | | ER |
| | B | 2 | G | N-3 | H, S | | DC |
| | C | 2 | G | O-2 | 1S | | |
| | D | 2 | G | O-2 | 1S | | |
| | E | 2 | G | O-2 | - | | |
| | F | 1 | G | O-2 | 4S | | PC |
| | G | 2 | G | O-2 | 4S | | DC |
| | BP | | | N-4.5 | | 1MS | 1 1/2" cover |
| 18 | A | 2 | G | N-3 | 2S | | DC, Pdet. |
| | B | 2 | G | N-3.5 | 2S | | |
| | C | 2 | G | O-2 | | | |
| | D | 2 | G | O-2 | 3S | | |
| | E | 2 | G | O-2.5 | 3S | | |
| | F | 1 | G | O-2 | 2S | | PC |
| | G | 2 | G | S-4 | | | |
| | BP | | | | | | |
| 19 | A | 2 | G | N | 3S | | ER |
| | B | 2 | G | N-3 | 1H | | RS |
| | C | 2 | G | O-2 | 4S | 1MS | |
| | D | 2 | G | O-2.5 | 4S | | |
| | E | 2 | G | O-2.5 | 3S | | |
| | F | 1 | 85 | O-2 | 3S | | PC |
| | G | None | G | N-4.5 | 1S | | |
| | BP | | | | 2S | | 1" cover |

| PILE # | | BOLTS | BEARING AREA | JACKET | CRACKS | SPALLS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 20 | A | None | G | N-3.5 | | | DC |
| | B | 2 | G | N-3.5 | | | DC |
| | C | 2 | G | O-2 | | | |
| | D | 2 | G | O-2 | 3S | | RS |
| | E | 2 | G | O-2.5 | 3S | | RS |
| | F | R | 85 | O-2 | 2S | | |
| | G | None | 90 | N-4.5 | 3S | | |
| | BP | | | | | 2MS | 3/4" cover |
| 21 | A | 2 | G | N-3 | 1S | | ER |
| | B | 2 | G | O-2 | 4S | | PC |
| | C | 2 | G | O-2 | 1H | | |
| | D | 2 | G | O-2 | 4S | | DC |
| | E | 1 | G | O-2 | 3S | | BS |
| | F | | N | O-2 | 3S | | BS |
| | G | 2 | | N-4 | 1H | | BS |
| | BP | | | | | | No cover, fallen |
| 22 | A | 2 | G | N-3 | 3S | | DC |
| | B | 2 | G | O-2 | 1H | 1MS | RS |
| | C | 2 | G | O-2 | 4S | | DC |
| | D | 2 | G | O-2.5 | 1S | 2MC | |
| | E | 2 | G | O-2.5 | 4S | | BS, PC |
| | F | 2 | G | O-2 | 3S | 1MS | BS |
| | G | 2 | 95 | N-4.5 | 2S | 2MC | DC |
| | BP | | | | | | 1" cover |
| 23 | A | 2 | G | N-3 | 1S | | PP |
| | B | 2 | G | O-2 | 5S | | MC, BS |
| | C | 2 | G | O-2 | 2S | | BS |
| | D | 2 | | O-2 | 4S | | BS |
| | E | 2 | G | O-2 | | 1MS | BS |
| | F | 1 | 30 | O-2 | 4S | | DC |
| | G | 1 | 75 | N-4 | | | |
| | BP | | | | | 4MC | 1" cover, PP |
| 24 | A | 2 | G | N-4 | | 3MC | BS, ER, RS |
| | B | 2 | G | O-2 | | 3MC | BS, DC |
| | C | 2 | G | O-2 | 3S | | RS, BS |
| | D | 2 | G | O-2 | 4S | | BS, PC |
| | E | 2 | G | O-2 | 4S | | BS |
| | F | R | 70 | O-2 | | 3MC | BS |
| | G | 1 | 80 | N-4 | | | PP |
| | BP | | | | | 1MC | 1/2" cover |
| 25 | A | 2 | 80 | S-3 | | | |
| | B | 2 | G | O-2 | 3S | | BS |
| | C | 2 | G | O-2 | 4S | | BS |
| | D | 2 | G | O-2.5 | | 4MC | BS |
| | E | 2 | G | O-2.5 | 1S | 1MC | |
| | F | None | G | O-2 | | 3MC | PD, BS |
| | G | None | G | O-4 | | | PP, BS, DC |
| | BP | | | N | | | 1" cover |

| PILE # | | BOLTS | BEARING AREA | JACKET | CRACKS | SPALLS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 26 | A | 2 | G | N-3 | 2S, 1h | | DC, BS |
| | B | 2 | G | N-3 | 1H | | ER, RS |
| | C | 2 | G | O-2 | 3S, 1H | | BS |
| | D | 2 | G | O-2 | 5S | 1MS | |
| | E | 2 | G | O-3 | 3S | | BS |
| | F | S | G | O-2.5 | | 4MC | RS, BS |
| | G | R | G | N-4 | 1H | | PP, DC |
| | BP | | | | | | |
| 27 | A | 2 | G | N-3 | 4S | | GC |
| | B | 2 | G | N-3.5 | 1H | | RS, HC |
| | C | 2 | G | O-2.5 | 3S | 1MS | RS |
| | D | 2 | G | O-2 | | 4MC | RS, BS |
| | E | 2 | G | N-4 | 1S | | GC |
| | F | None | G | O-2 | | 1MS | PD, twisted, RS, ER, BS |
| | G | None | 40 | N-4 | 1H, 1S | | PP |
| | BP | | | | | | |
| 28 | A | 2 | G | S-3 | | | |
| | B | 2 | G | S-2 | | | |
| | C | 2 | G | O-2 | 1S | | |
| | D | 2 | G | O-2 | 3S | 2MS | PC, HC |
| | E | 2 | G | O-2 | 4S | | |
| | F | R | 80 | O-2 | | 1MS | 2" cover, BS |
| | G | None | 90 | N-4 | 2S | | PP, PC |
| | BP | | | | | | V, DC |
| 29 | A | 2 | G | N-4 | 3S | | V, RS |
| | B | 1 | G | O-2 | | 5MC | |
| | C | 2 | G | O-2 | 2S | | ER |
| | D | 2 | G | O-2.5 | 3S, 1H | | ER |
| | E | 2 | G | O-2 | 4S, 1h | | |
| | F | R | G | O-2 | 3S | | |
| | G | None | | | 3S | 1MS | No cover |
| | BP | | | | | | |
| 30 | A | 1 | 60 | N-4 | 1S | | GC |
| | B | 1 | G | O-2 | 4S | | |
| | C | 2 | G | O-2.5 | 2S, 2H | | BS |
| | D | 2 | G | O-2 | 2S | 1MS | ER |
| | E | 2 | G | O-2 | 3S, 1H | | ER |
| | F | S | 70 | O-2 | 3S | | BS |
| | G | 1 | 90 | S-4 | | | MC |
| | BP | | | | | | 1 1/2" cover |
| 31 | A | 1 | G | N-2 | 3S, 1h | | |
| | B | 1 | 80 | S-3 | | | |
| | C | 2 | G | O-2 | 1S | | |
| | D | 2 | G | O-2 | 4S, 1h | | BS, HC |
| | E | 2 | G | O-2 | 4S | | ER, BS |
| | F | 1 | 70 | O-2 | 4S | | |
| | G | 1 | G | N-4.2 | 1H | | |
| | BP | | | | | | V (large), bad splice |

| PILE # | | BOLTS | BEARING AREA | JACKET | CRACKS | SPALLS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 32 | A | None | G | N-4 | 5S, 2H | | PC |
| | B | None | 80 | N-2 | 2S | | DC, HC, RS |
| | C | 2 | G | O-2 | 2S | | |
| | D | 2 | G | N-3 | 2S | | |
| | E | 1 | G | O-2 | 4S | | ER, DC |
| | F | 1 | 80 | O-2 | 3S | | RS, DC |
| | G | 1 | 60 | N-4 | 1S, 1H | | DC, PP |
| | BP | | | | | | PP, MC |
| 33 | A | 2 | G | N-3.5 | 2S | | H, A, PP, RS |
| | B | 1 | G | O-2 | 3S | | BS |
| | C | 2 | G | O-2 | 4S | | DC |
| | D | 2 | G | O-2 | 3S | | RS, PC |
| | E | 2 | G | O-2 | 4S | 1MS | BS |
| | F | None | 50 | O-2 | 4S | 1MS | |
| | G | 2 | G | N-4 | | | |
| | BP | | | | | 1MS | 1" cover |
| 34 | A | 2 | G | N-4 | 2S | | A, HC |
| | B | S | 50 | S-2 | 4S | | DC |
| | C | 2 | G | S-2 | 3S | | |
| | D | 2 | G | S-2 | 4S, 1H | | RS, DC |
| | E | 2 | 80 | S-2 | | 4MC,1MS | close to F row |
| | F | R | 80 | S-2 | 4S | | HC |
| | G | 2 | 60 | N-4 | 1H | | H |
| 35 | A | 2 | G | N-3 | 5S, 1h | | DC, PP |
| | B | S | 90 | O-2 | 1S | | MC |
| | C | 2 | G | O-2 | 3S, 1h | | DC |
| | D | 2 | G | Sq-3 | 1H | | |
| | E | 2 | G | O-2 | 4S | | HC |
| | F | None | 50 | O-2 | 3S | | ER |
| | G | R | G | N-4.5 | 1H | | DC |
| | BP | | | | | | 1" cover |
| 36 | A | None | G | N-2 | 3S | | |
| | B | 1 | 60 | O-2 | 2S | | BS |
| | C | 2 | G | O-2 | 1S, 1H | | BS |
| | D | 2 | G | O-2 | 4S | | PC |
| | E | 2 | G | N-3.5 | 2S | | RS |
| | F | None | 50 | O-2 | 4S | | A, H, PC |
| | G | None | G | S-4 | | | MC |
| | BP | | | | 1S, 5H | | MC, ER |
| 37 | A | 2 | G | N-3.5 | 3S, 1h | | PP |
| | B | 1 | 60 | O-2 | 2S | 1MS | |
| | C | 2 | G | O-2 | 3S | | BS |
| | D | 2 | G | O-2 | | 2MS | HC |
| | E | 2 | G | O-2 | 3S | | BS |
| | F | None | 30 | O-2 | 3S | 1MS | |
| | G | 1 | G | N-4 | 4H | | PP |
| | BP | | | | 4S | | Bad splice (bent) |

| PILE # | | BOLTS | BEARING AREA | JACKET | CRACKS | SPALLS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 38 | A | 2 | G | N-5 | 1H | | |
| | B | 2 | 40 | O-2 | 4S | | PC |
| | C | 2 | G | O-2 | 3S | | DC |
| | D | 2 | G | O-2 | 4S | | HC |
| | E | 2 | G | O-2 | 4S | | BS |
| | F | R | G | O-2 | 2S | 1MS | |
| | G | None | 50 | N-3 | | | GC, MC |
| | BP | | | | | | |
| 39 | A | S | G | N-4 | | | GC |
| | B | None | G | O-2 | 4S | 1MS | RS |
| | C | 2 | G | N-6 | 1H | | |
| | D | 2 | G | O-2 | | 4MC | BS |
| | E | 2 | G | O-2 | | 2MS | PD, 30% jacket off, HC |
| | F | None | G | O-2 | | 4MC | BS |
| | G | 1 | N | N-4 | | | 1/2" cover, PP |
| | BP | | | | 4S | | 1/2" cover, PP |
| 40 | A | R | 90 | N-4 | | | PP |
| | B | 2 | G | O-2.5 | 2S | 2MC | |
| | C | 2 | G | O-2 | 3S | | |
| | D | 2 | G | O-2 | 4S | | ER |
| | E | 2 | G | O-2 | 4S | | BS |
| | F | None | 40 | O-2 | 4S | | ER, BS |
| | G | None | 25 | S-3.5 | | | |
| | BP | | | | 3S | | 1 1/2" cover, PP |
| 41 | A | R | G | N-4 | 1H, 1h | | GC |
| | B | 1 | G | O-2 | 2S | | DC |
| | C | 2 | G | O-2 | 3S | | DC |
| | D | 2 | G | O-2 | 5S | 1MS | RS, HC |
| | E | 2 | G | N-3.5 | 2S | | PP |
| | F | 2 | 90 | N-4 | | | ER |
| | G | 1 | 50 | N-3.5 | 3S | | |
| | BP | | | | 3S | | 1/2" cover |
| 42 | A | S | G | S-4.5 | | | Pdet, BS |
| | B | 2 | G | O-2 | | 4MC | BS |
| | C | 2 | G | N-3.5 | | | PP |
| | D | 2 | G | O-2 | 4S | | RS, DC |
| | E | 2 | G | O-2 | 4S | | BS, HC |
| | F | None | G | N-4 | 1H | | PP |
| | G | None | 10 | S-4 | | | Pdet |
| | BP | | | | | | |
| 43 | A | R | G | N-4 | 4S | | PP |
| | B | R | G | O-2 | 4S | 1MS | |
| | C | 2 | G | O-2 | 3S | | HC, DC |
| | D | 2 | G | O-2 | | 4MC | HC |
| | E | 2 | G | N-3.5 | 5S | 1MS | HC |
| | F | None | 50 | N-4 | 1S, 2h | | |
| | G | 1 | 65 | N-4 | | | PP |
| | BP | | | | 5SP | | 3/4" cover, DC |

| PILE # | | BOLTS | BEARING AREA | JACKET | CRACKS | SPALLS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 44 | A | R | G | N-4 | 3S | | Pdet, ER, DC |
| | B | R | G | N-4.5 | | | RS, PP |
| | C | 2 | G | O-2 | 4S | | |
| | D | 2 | G | O-2 | 4S | | DC, HC |
| | E | 2 | G | O-2 | 4S | 1MC | HC, DC, BS |
| | F | R | G | N-4 | 2S, 1h | | ER, 1" cover |
| | G | None | N | S-4 | | | |
| | BP | | | | 2S | | MC |
| 45 | A | R | G | N-5 | 1S | | PP |
| | B | None | G | N-5 | | | GC |
| | C | 2 | G | O-2 | 4S | | DC |
| | D | 2 | G | O-2 | 4S | 1MC | HC |
| | E | 2 | G | O-2 | 4S | 1MS | HC |
| | F | 2 | 90 | N-3.5 | 3S | | ER, MC |
| | G | 2 | 80 | N-4 | 1S | | ER |
| | BP | | | | 2S | | 3/8" cover, flange exposed |
| 46 | A | S | G | N-6 | 1H | | PP |
| | B | None | | O-2 | 4S | 2MS | DC |
| | C | 2 | G | O-2 | 4S, 1h | | |
| | D | 2 | G | O-2 | 4S, 1h | | HC |
| | E | 2 | G | N-4 | 3S, 1h | | 1" cover |
| | F | R | 75 | O-2 | 4S | 2MS | Pdet, HC |
| | G | 1 | 85 | S-3.5 | | | 70% jacket gone |
| | BP | | | | | | |
| 47 | A | S | G | N-5 | | | Pdet, GC |
| | B | | G | O-2 | 4S | | |
| | C | | G | O-2 | 2S | | |
| | D | | G | O-2 | | 1MS,4MC | HC |
| | E | | G | O-2 | 3S | 2MS | |
| | F | None | G | O-2 | 4S | 1MS,1MC | |
| | G | None | 35 | N-4.5 | 3S | | DC |
| | BP | | | | 4S, 1h | | MC,PP |
| 48 | A | None | G | N-5 | | | GC |
| | B | | G | O-2 | 3S | 1MS | RS |
| | C | | G | O-2 | 4S, 1h | | |
| | D | | G | O-2 | 4S | | DC, RS, HC |
| | E | | G | O-2 | 4S | | DC |
| | F | R | G | O-2 | 4S | | DC |
| | G | S | G | S-3.5 | | | Fallen, no cover |
| | BP | | | | 2S | | No cover, fallen, PP |
| 49 | A | S | 20 | N-5 | 2S | | DC |
| | B | None | G | N-4 | 3S | | |
| | C | | G | S-4.5 | | | |
| | D | | G | O-2 | 4S | | MC, HC |
| | E | | G | O-2 | 4S | | DC |
| | F | R | G | O-2 | 4S | | RS, HC |
| | G | None | N | N-4 | 3S | | Pdet |
| | BP | | | | 3S | | 3/4" cover, PP |

| PILE # | | BOLTS | BEARING AREA | JACKET | CRACKS | SPALLS | COMMENTS |
|---|---|---|---|---|---|---|---|
| 50 | A | 2 | G | S-4 | | | |
| | B | 1 | G | O-2 | 4S | | DC |
| | C | 2 | G | O-2 | 4S | | DC |
| | D | 2 | G | O-2 | 5S | | RS, HC |
| | E | 2 | G | O-2.5 | 4S, 1h | | HC, DC |
| | F | None | G | O-2 | 4S, 1h | | HC, DC |
| | G | S | N | S-4 | | | |
| | BP | | | | | | |

## GLOSSARY OF SYMBOLS FOR BENTS #2 THRU #50

**Fasteners**

2...................2 bolts
1...................1 bolt
S...................Spike
R...................Rebar
-...................Not applicable

**Bearing**

G...................100%
N...................None
20..................20%

**Jacket**

S...................Sonotube
O...................Old style
N...................Long new style
Sq..................Square (24")
-2..................2' height above waterline

**Cracks**

1S..................1 spall crack
1H..................1 hairline crack
1h..................1 horizontal crack

**Spalls**

1 MC................1 major spalling crack
1 MS................1 major spall
1 SS................1 small spall

**Comments**

GC..................Good concrete
PC..................Poor concrete
ER..................Rebar exposed
G...................Jacket in good condition
DC..................Deteriorated concrete
HC..................Heavy corrosion just above jacket
A...................Pile is angled 5° or more
PP..................Powdery/porous concrete
RS..................Rust stains in concrete jacket
PD..................Pile previously displaced
P Det...............Pile cap deteriorating
BS..................Bottom of jacket spalling
MC..................Minimal coverage of concrete
H...................Hole in pile
NJ..................Not jacketed
V...................Voids in concrete
1" cover............1" coverage of concrete over steel

APPENDIX III

PIER LIMA
NAVAL STATION, GUANTANAMO BAY, CUBA

PILE INSPECTION DATA
BENTS #51 THRU #81

| PILE NO. | | DBJ | JT | MFC | DAB | PPCC | BC | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| 56 | A | N | S | 2 | A | N | N | |
| | B | N | R | N | N | N | N | |
| | C | N | R | N | N | N | N | |
| | D | N | O | 2 | A | N | N | Jacket cracked along flange |
| | E | N | R | N | N | N | N | |
| | F | N | R | N | N | 80 | P | 10° twist |
| | G | N | R | N | N | N | N | Heavy pitting below jacket,bent flan |
| | GB | N | | | | | | |
| 57 | A | N | R | N | A | N | P | |
| | B | N | R | N | N | N | N | 10° twist |
| | C | A | R | N | N | N | N | |
| | D | N | O | N | A | N | N | Jacket cracked along flange |
| | E | A | O | N | A | N | N | Jacket cracked along flange |
| | F | A | O | N | A | 50 | P | Jacket cracked along flange |
| | G | N | R | N | N | N | N | |
| | AB | N | R | N | N | N | N | |
| 58 | A | N | S | 1 | N | N | P | 10° twist |
| | B | N | R | N | N | N | N | |
| | C | N | R | N | A | N | N | Pitting below jacket |
| | D | A | O | N | A | N | N | Bad delamination above jacket, JC |
| | E | N | R | N | A | N | N | |
| | F | A | R | 1 | A | 75 | P | flange exposed below surface |
| | G | N | R | <1 | A | N | N | 20° twist |
| | GB | N | R | N | A | N | N | Pitted below jacket |
| 59 | A | N | R | N | N | N | P | |
| | B | N | R | N | N | N | N | |
| | C | N | R | N | N | N | N | |
| | D | A | O | 2 | A | N | N | Jacket cracked along flange |
| | E | N | O | <1 | A | N | N | Bad jacket deterioration |
| | F | A | R | N | A | 50 | P | 20° twist |
| | G | N | R | 2 | A | N | N | |
| | AB | N | R | 2 | N | N | N | |
| 60 | A | A | S | <1 | N | N | N | |
| | B | A | R | N | N | N | N | |
| | C | A | O | N | A | N | N | Bad jacket deterioration |
| | D | N | R | N | N | N | N | |
| | E | A | O | N | A | N | N | 1" flange hole below jacket, JC |
| | F | N | R | N | A | N | P | |
| | G | A | R | 1 | N | N | N | Bad pitting on web below jacket |
| | GB | N | R | 2 | N | N | N | |

| PILE NO. | | DBJ | JT | MFC | DAB | PPCC | BC | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| 61 | A | A | S | 2 | N | N | N | |
| | B | N | S | 1 | N | N | N | |
| | C | A | R | 1 | N | N | N | |
| | D | A | R | 2 | N | N | N | Two 3" jacket holes exposing flange |
| | E | N | R | N | A | N | N | Pitting below jacket |
| | F | N | R | N | A | 50 | P | |
| | G | N | R | N | A | N | N | |
| | AB | N | R | 2 | N | N | N | |
| 62 | A | N | S | 1 | N | N | N | 10° twist |
| | B | A | R | 1 | N | N | N | |
| | C | A | R | N | N | N | N | Failed flange above jacket |
| | D | A | R | N | N | N | N | 1-1/2" notch in flange |
| | E | A | R | N | A | N | N | |
| | F | N | R | N | A | 90 | N | 10° twist |
| | G | N | S | 1 | A | 50 | P | |
| | GB | A | R | 2 | A | N | N | Pitted webbing below jacket |
| 63 | A | A | S | 1 | N | N | N | |
| | B | N | S | 2 | N | 80 | N | Old adjacent pile replaced |
| | C | A | S | <1 | N | N | N | |
| | D | N | S | 1 | N | N | N | |
| | E | N | S | 1 | N | 80 | N | Pile not vertical |
| | F | A | S | 2 | N | 50 | U | |
| | G | A | S | N | A | 10 | P | Jacket pouring incomplete, PL |
| | AB | N | R | <1 | N | N | N | Jacket cracked along flange |
| 64 | A | N | S | 1 | N | N | N | |
| | B | N | S | N | N | 80 | N | Old adjacent pile replaced |
| | C | N | S | 2 | N | 70 | N | Old adjacent pile replaced |
| | D | N | S | 2 | N | N | N | |
| | E | A | S | N | N | N | P | |
| | F | N | S | 1 | A | 40 | N | |
| | G | A | S | 2 | A | N | N | |
| | GB | N | R | 1 | N | N | N | |
| 65 | A | N | S | <1 | N | N | N | 10° twist |
| | B | N | S | N | N | N | N | Old adjacent pile replaced |
| | C | A | S | N | N | N | N | |
| | D | N | S | 2 | N | N | N | |
| | E | A | S | 2 | N | N | N | 10° twist |
| | F | N | S | N | A | 50 | U | |
| | G | A | R | N | A | N | N | 4" necking below jacket |
| | AB | A | R | 2 | A | N | N | |

| PILE NO. | | DBJ | JT | MFC | DAB | PPCC | BC | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| 66 | A | N | S | <1 | N | N | N | 20° twist |
| | B | N | S | N | N | N | N | 2" hole in flange |
| | C | N | S | | N | N | N | |
| | D | N | S | | N | N | N | |
| | E | N | S | | N | N | N | |
| | F | N | S | 2 | A | 30 | U | 10° twist |
| | G | N | S | 2 | A | N | N | Hour glass below jacket |
| | GB | N | R | <1 | N | N | N | Spliced 3/4" bolts thru 1" hole |
| 67 | A | N | S | <1 | A | N | N | |
| | B | A | S | N | N | N | N | 10° twist, bad pitting |
| | C | A | S | 1 | N | N | N | 5° twist |
| | D | | | | | | | |
| | E | A | S | N | N | N | N | |
| | F | N | S | 1 | N | N | N | |
| | G | A | S | N | A | N | N | |
| | AB | N | R | N | N | N | N | |
| 68 | A | N | S | | A | N | N | Jacket cracked at flange, 10° Twist |
| | B | N | S | N | N | 90 | N | 10° twist |
| | C | N | S | | N | N | N | |
| | D | N | S | | A | N | N | |
| | E | N | S | | N | N | N | |
| | F | N | S | | A | N | N | |
| | G | N | S | 2 | A | N | N | |
| | GB | N | R | 2 | N | N | N | |
| 69 | A | N | S | 2 | N | N | P | 10° twist |
| | B | N | S | 2 | N | 80 | N | 20° twist |
| | C | A | S | | N | N | N | 15° twist |
| | D | N | S | | N | N | N | |
| | E | A | S | | N | N | N | |
| | F | N | S | | A | N | N | 15° twist |
| | G | A | S | 1 | N | N | N | |
| | AB | N | R | N | N | N | N | |
| 70 | A | N | S | 2 | N | N | N | Tilted pile with 25% cap contact |
| | B | N | S | 1 | N | N | N | |
| | C | N | S | | N | N | N | |
| | D | N | S | | N | N | N | |
| | E | N | S | | A | N | N | aggregate visible on jacket |
| | F | N | S | | N | 75 | N | 15° twist |
| | G | N | S | | N | N | N | |
| | GB | N | R | 2 | N | N | N | |

| PILE NO. | | DBJ | JT | MFC | DAB | PPCC | | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| 51 | A | N | R | N | A | 80 | P | |
| | B | N | S | N | N | 10 | U | Broken brace |
| | C | A | O | | A | N | N | One side jacket missing |
| | D | N | O | | A | N | N | Two sides missing, flange bent |
| | E | N | S | ∠1 | N | N | N | 10° twist |
| | F | A | O | N | A | 40 | U | JC, HP, NJ |
| | G | | | | | | | |
| | AB | A | R | 1 | A | N | N | |
| 52 | A | N | R | N | N | 90 | P | 20° twist |
| | B | N | S | 2 | N | N | N | |
| | C | A | | | A | N | U | No jacket |
| | D | N | | | A | 80 | U | No jacket |
| | E | N | S | ∠1 | A | N | P | |
| | F | N | R | 2 | N | 80 | N | 10° twist |
| | G | N | | | | | | |
| | GB | N | | | | | | Pitted below jacket |
| 53 | A | N | R | N | N | N | P | |
| | B | A | R | N | N | 90 | N | Cap pile partially broken, HP |
| | C | N | S | N | N | N | N | |
| | D | N | O | N | A | N | N | Jacket cracked along flange |
| | E | N | O | N | A | N | N | Jacket cracked along flange |
| | F | N | R | N | N | N | N | |
| | G | N | | | | | | |
| | AB | N | R | N | N | N | N | Jacket cracked along flange |
| 54 | A | N | S | R | N | 50 | P | Cap pile deterioration |
| | B | N | O | N | N | N | N | Jacket cracked along flange |
| | C | A | O | N | A | N | N | Jacket cracked along flange |
| | D | N | R | N | N | N | N | |
| | E | N | O | N | A | N | N | Jacket cracked along flange |
| | F | N | O | N | A | 90 | N | Jacket cracked along flange, T-10° |
| | G | N | | | | | | Heavy pitting below jacket |
| | GB | N | | | | | | |
| 55 | A | N | R | N | A | 60 | P | Cap pile deteriorated, T-10° |
| | B | N | R | N | N | N | N | |
| | C | N | R | N | N | N | N | |
| | D | N | O | 2 | A | N | N | Jacket cracked along flange |
| | E | N | O | <1 | A | N | N | Bad jacket deterioration |
| | F | A | R | N | N | 60 | U | |
| | G | N | | | | | | |
| | AB | N | R | 1 | N | N | N | |

| PILE NO. | | DBJ | JT | MFC | DAB | PPCC | BC | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| 71 | A | N | S | N | N | N | N | 10° twist |
| | B | N | S | N | N | N | N | |
| | C | N | S | | N | N | P | |
| | D | N | S | | N | N | N | |
| | E | A | S | | N | N | N | |
| | F | N | S | | N | 50 | P | |
| | G | N | S | 1 | N | N | P | Aggregate visible |
| | AB | N | R | N | N | N | N | |
| 72 | A | N | S | 1 | N | N | N | Pitted below jacket |
| | B | N | S | N | N | N | N | |
| | C | N | S | | N | N | N | |
| | D | N | S | | N | N | N | |
| | E | N | S | | N | N | N | |
| | F | N | S | | A | 50 | P | |
| | G | N | S | 1 | A | 50 | P | |
| | AB | N | R | 2 | N | N | N | 20° twist |
| | GB | N | R | O | A | N | N | |
| 73 | A | N | S | 1 | A | 20 | N | 20° twist |
| | B | A | S | N | N | N | N | |
| | C | N | S | | N | 75 | N | |
| | D | N | S | | N | N | N | |
| | E | N | S | | N | N | N | |
| | F | N | S | | N | N | N | |
| | G | N | S | | A | 50 | P | |
| 74 | A | N | S | 2 | N | 90 | N | 10° twist, adjacent pile replaced |
| | B | N | S | 1 | N | N | N | |
| | C | | | | | | | |
| | D | N | S | | N | N | N | |
| | E | N | S | | N | 75 | P | |
| | F | N | S | | N | 10 | P | |
| | G | N | S | $\leq 1$ | N | N | N | |
| | AB | | R | $\leq 1$ | A | N | N | |
| | GB | N | R | 2 | N | N | N | |
| 75 | A | A | S | 2 | N | N | N | |
| | B | N | S | 2 | N | N | N | 20° twist |
| | C | N | S | | N | N | N | |
| | D | N | S | | N | N | N | |
| | E | A | S | | N | N | N | |
| | F | N | S | | N | N | P | |
| | G | A | S | | N | 40 | P | Hour glass below jacket |

| PILE NO. | | DBJ | JT | MFC | DAB | PPOC | BC | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| 76 | A | N | S | N | N | N | N | |
| | B | A | S | 2 | N | 90 | N | 10° twist |
| | C | N | S | | N | N | N | |
| | D | A | S | | N | N | N | |
| | E | N | S | | N | N | N | |
| | F | N | S | | N | 10 | U | |
| | G | N | S | 1 | N | 50 | P | |
| | AB | | R | N | N | N | N | |
| | GB | N | R | 1 | N | N | N | |
| 77 | A | N | S | <1 | N | O | P | End cap pile deteriorated |
| | B | N | S | N | N | N | N | |
| | C | A | S | | N | N | N | Hole in flange 3' below jacket |
| | D | N | S | | N | N | N | |
| | E | A | S | | N | O | U | Loose pile |
| | F | N | S | <1 | N | 50 | P | |
| | G | N | S | | N | N | N | 10° twist |
| 78 | A | N | S | 1 | N | N | N | |
| | B | N | S | 1 | N | N | N | |
| | C | N | S | | N | N | N | |
| | D | N | S | | N | N | N | |
| | E | A | S | | N | N | N | |
| | F | A | S | | N | 80 | N | |
| | G | N | R | O | N | N | N | |
| | AB | | R | 2 | N | N | N | |
| | GB | N | R | 1 | N | N | N | |
| 79 | A | N | | | A | N | N | No jacket, adjacent pile replaced |
| | B | A | S | 1 | N | N | N | |
| | C | A | S | | N | 80 | N | |
| | D | N | S | | N | 50 | P | |
| | E | N | S | | N | 80 | N | |
| | F | A | S | | N | N | N | |
| | G | N | S | | N | N | N | |
| | AB | | R | 2 | N | N | N | |
| | GB | N | R | 1 | N | N | N | |
| 80 | A | N | | | N | N | N | No jacket |
| | B | N | S | 2 | N | N | N | |
| | C | | | | | | | |
| | D | | | | | | | |
| | E | A | S | | N | N | N | |
| | F | A | S | | N | N | N | |
| | G | N | S | | A | N | N | |
| | AB | | R | 2 | N | N | N | |
| | GB | N | R | 1 | N | N | N | |

| PILE NO. | | DBJ | JT | MFC | DAB | PPCC | BC | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| 81 | A | A | | | A | 90 | P | No jacket |
| | B | N | S | N | N | N | N | |
| | C | A | S | | N | 75 | | |
| | D | N | S | | N | N | N | |
| | E | N | S | | N | N | N | Hole in webbing 3' below jacket |
| | F | | | | | | | |
| | G | A | S | | N | N | P | |
| | AB | N | R | 2 | N | N | N | |
| | GB | A | R | 2 | N | N | N | Hole in web at cap |

## GLOSSARY OF SYMBOLS FOR BENTS #51 THRU #81

BJD...........Below jacket deterioration
A.............Accelerated
N.............Normal

JT............Jacket type
S.............Sonotube
R.............Regular
O.............Old style

MFC...........Minimum flange coverage
N.............Normal
2.............2"
1.............1"

DAB...........Deterioration above jacket
A.............Accelerated
N.............Normal

PPCC..........Percentage pile cap coverage
N.............Normal

BC............Bolt Connection
P.............Partial
N.............Normal
U.............Unattached

NJ............No jacket
T-10°.........Twist in pile 10°
HP............Heavy pitting below jacket
JC............Jacket cracked along flange
PL............Partial loss of jacket

APPENDIX IV

PIER LIMA
NAVAL STATION, GUANTANAMO BAY, CUBA

ULTRASONIC THICKNESS DATA

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

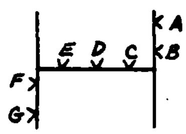
DATE: 7/31/79 BENT # 14 [XX] PLUMB [ ] BATTER PILE # G

CONDITION OF CAP:

CONDITION OF JACKET:

ULTRASONIC READING:

ELEV: 6" Under Jacket




C - Large Pits

E - Large pits .180, .150 deep

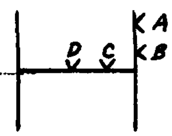
F - Large pits .130 deep

G - Large pits

| A. | C. | E. | G. |
|---|---|---|---|
| 0.402 | 0.425 | 0.418 | 0.365 |
| .430 | .425 | .418 | .308 |
| .457 | .424 | .417 | .307 |
| .459 | .425 | .418 | .291 |
| .457 | .425 | .418 | .297 |
| .417 | .425 | .421 | .268 |
| .450 | .426 | .416 | .306 |
| | .425 | .415 | .307 |
| Av. 0.439 | Av. 0.426 | Av. 0.418 | Av. 0.306 |

| B. | D. | F. |
|---|---|---|
| 0.316 | 0.427 | 0.441 |
| .317 | .450 | .450 |
| .317 | .459 | .324 |
| .326 | .439 | .326 |
| .317 | .424 | .324 |
| .316 | .424 | .418 |
| .317 | .425 | .436 |
| .321 | .429 | .397 |
| Av. 0.318 | Av. 0.435 | Av. 0.390 |

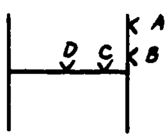
ELEV: -8' Pneumo




B - Many shallow pits

| A. | B. | C. | D. |
|---|---|---|---|
| 0.392 | 0.383 | 0.436 | 0.402 |
| .370 | .389 | .436 | .402 |
| .388 | .387 | .436 | .402 |
| .370 | .383 | .435 | .408 |
| .382 | .321 | .458 | .409 |
| .402 | .312 | .473 | .405 |
| .370 | .314 | .440 | .408 |
| | .388 | .439 | .406 |
| Av. 0. 382 | Av. 0.360 | Av. 0.444 | Av. 0.405 |

ELEV: -16' Pneumo




Note: opposite side

F - some pitting

| D. | E. | F. | G. |
|---|---|---|---|
| 0.433 | 0.418 | 0.480 | 0.465 |
| .432 | .410 | .481 | .457 |
| .432 | .412 | .481 | .458 |
| .430 | .416 | .378 | .457 |
| .431 | .415 | .331 | .457 |
| .432 | .416 | .378 | .458 |
| .433 | .415 | .425 | |
| .433 | | .429 | |
| Av. 0.432 | Av. 0.415 | Av. 0.423 | Av. 0.459 |

COMMENTS, CALIBRATIONS: .488

GENERAL PIER CONDITION: Note: Supposedly 12" HP-53

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

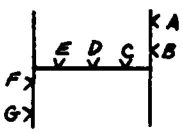
DATE: 7/31/79 BENT # 15 [XX] PLUMB [ ] BATTER PILE # F

CONDITION OF CAP: ____________________

CONDITION OF JACKET: ____________________

ULTRASONIC READING:

ELEV: 8" Under Jacket




A - All large Pits

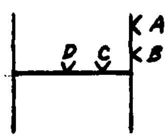
Also large pits between D & E

G - Considerable pitting

| A. | C. | E. | G. |
|---|---|---|---|
| 0.196 | 0.495 | 0.488 | 0.440 |
| .189 | .496 | .474 | .362 |
| .223 | .495 | .478 | .354 |
| .221 | .461 | .467 | .363 |
| .213 | .461 | .449 | .431 |
| .204 | .462 | .449 | .412 |
| .189 | .471 | .455 | .379 |
| .307 | .472 | .457 | .393 |
| Av. 0.218 | Av. 0.477 | Av. 0.465 | 0.391 |

| B. | D. | F. |
|---|---|---|
| 0.444 | 0.494 | 0.432 |
| .446 | .492 | .433 |
| .442 | .494 | .407 |
| .443 | .481 | .446 |
| .433 | .497 | .472 |
| .434 | .498 | .403 |
| .436 | .497 | .420 |
| .434 | | .406 |
| Av. 0.439 | Av. 0.493 | Av. 0.427 |

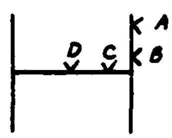
ELEV: -8' (pneumo)




Calibration .488 .489

| A. | B. | C. | D. |
|---|---|---|---|
| 0.450 | 0.502 | 0.470 | 0.418 |
| .452 | .504 | .472 | .418 |
| .454 | .414 | .474 | .418 |
| .463 | .413 | .475 | .417 |
| .459 | .412 | .418 | .421 |
| .466 | .412 | .417 | .432 |
| .413 | .418 | .418 | .417 |
| .453 | | | .417 |
| Av. 0.451 | Av. 0.439 | Av. 0.449 | Av. 0.420 |

ELEV: -18' (pneumo)




| A. | B. | C. | D. |
|---|---|---|---|
| 0.481 | 0.481 | 0.411 | 0.426 |
| .487 | .489 | .408 | .428 |
| .438 | .491 | .410 | .427 |
| .490 | .489 | .411 | .425 |
| .481 | .490 | .414 | .426 |
| | | .412 | .425 |
| | | | .425 |
| Av. 0.475 | Av. 0.488 | Av. 0.411 | Av. 0.426 |

COMMENTS, CALIBRATIONS:

Pit gauage showed pits at elev. under jacket as follows: @ A 0.320 between D & E 0.240

GENERAL PIER CONDITION: Note: Supposedly 12" HP-53

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

DATE: 7/31/79 BENT # 15 [XX] PLUMB [ ] BATTER PILE # G

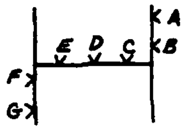
CONDITION OF CAP: ______

CONDITION OF JACKET: ______

ULTRASONIC READING:

ELEV: 6" Under Jacket

A - Large pits
pit gauge
.310
.295

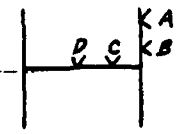



G - Large pits
1 1/2"
diameter
Pit Gauage
.330

| A. | C. | E. | G. |
|---|---|---|---|
| 0.457 | 0.475 | 0.415 | 0.449 |
| .436 | .443 | .416 | .451 |
| .435 | .441 | .415 | .457 |
| .438 | .425 | .415 | .469 |
| .435 | .433 | .416 | .457 |
| | .435 | .415 | .452 |
| | | | .453 |
| | | | .452 |
| Av. 0.440 | Av. 0.442 | Av. 0.415 | AV. 0.455 |

| B. | D. | F. |
|---|---|---|
| 0.457 | 0.378 | 0.437 |
| .456 | .378 | .451 |
| .465 | .373 | .418 |
| .465 | .368 | .401 |
| .432 | .369 | .413 |
| .457 | .370 | .438 |
| .452 | .371 | .427 |
| .456 | .373 | |
| Av. 0.455 | Av. 0.378 | AV. 0.425 |

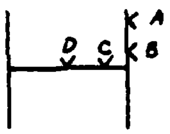
ELEV: -15' Pneumo




B - Large pits

| A. | B. | C. | D. |
|---|---|---|---|
| 0.357 | 0.326 | 0.425 | 0.395 |
| .357 | .307 | .425 | .396 |
| .355 | .316 | .425 | .395 |
| .412 | .355 | .426 | .396 |
| .358 | .356 | .425 | .396 |
| .357 | .357 | .426 | .395 |
| .369 | .353 | .427 | .396 |
| | .356 | .426 | .398 |
| AV. 0.366 | AV. 0.341 | AV. 0.426 | AV. 0.396 |

ELEV: -25' Pneumo




| A. | B. | C. | D. |
|---|---|---|---|
| 0.442 | 0.442 | 0.425 | 0.408 |
| .441 | .459 | .425 | .404 |
| .448 | .444 | .423 | .402 |
| .450 | .455 | .432 | .405 |
| .460 | .437 | .426 | .405 |
| .457 | .438 | .428 | .407 |
| .457 | .438 | .430 | .405 |
| | .464 | .428 | .403 |
| AV. 0.451 | AV. 0.447 | AV. 0.427 | AV. 0.405 |

COMMENTS, CALIBRATIONS: ______

GENERAL PIER CONDITION: ______

Note: Supposedly 12" HP-53

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

DATE: 7/31/79 BENT # 16 [XX] PLUMB [ ] BATTER PILE # G

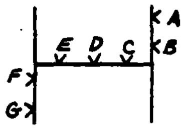
CONDITION OF CAP:

CONDITION OF JACKET:

ULTRASONIC READING:

ELEV: 6" Under Jacket

C - Pits .200 deep

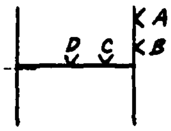



G - Caliper check .450

| A. | C. | E. | G. |
|---|---|---|---|
| 0.457 | 0.433 | 0.415 | 0.430 |
| .480 | .458 | .417 | .435 |
| .485 | .462 | .415 | .433 |
| .429 | .433 | .417 | .431 |
| .437 | .457 | .421 | .431 |
| .457 | .450 | .407 | .431 |
| .402 | .472 | .417 | .432 |
| .410 | .401 | .417 | |
| Av. 0.445 | Av. 0.446 | Av. 0.416 | Av. 0.432 |

| B. | D. | F. |
|---|---|---|
| 0.502 | 0.376 | 0.427 |
| .482 | .375 | .426 |
| .483 | .376 | .433 |
| .484 | .375 | .428 |
| .488 | .378 | .425 |
| .489 | .380 | .426 |
| .459 | .378 | |
| Av. 0.484 | Av. 0.377 | Av. 0.428 |

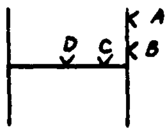
ELEV: -15'




See Below

| A. | B. | C. | D. |
|---|---|---|---|
| 0.442 | 0.459 | 0.386 | 0.370 |
| .448 | .465 | .385 | .370 |
| .443 | .460 | .383 | .371 |
| .457 | .465 | .386 | .370 |
| .455 | .463 | .386 | .373 |
| .452 | .488 | .392 | .380 |
| .451 | .462 | .378 | .370 |
| .452 | .461 | | .371 |
| Av. 0.450 | Av. 0.465 | Av. 0.385 | Av. 0.372 |

ELEV: -25'




| A. | B. | C. | D. |
|---|---|---|---|
| 0.444 | 0.432 | 0.443 | 0.354 |
| .450 | .430 | .444 | .360 |
| .449 | .431 | .444 | .363 |
| .453 | .437 | .454 | .356 |
| .457 | .432 | .433 | .355 |
| .449 | .449 | .446 | .354 |
| .441 | .450 | .426 | .361 |
| .451 | .450 | .428 | .359 |
| Av. 0.449 | Av. 0.439 | Av. 0.440 | Av. 0.358 |

COMMENTS, CALIBRATIONS: Internal test = 0.200 Test block = 0.490

At 1" from edge of flange near "A" .412, .416, .418, .417, .415

GENERAL PIER CONDITION:

Note: Supposeldy 12" HP-53

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

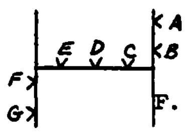
DATE: 8/2/79  BENT # 37  [XX] PLUMB  [ ] BATTER  PILE # E

CONDITION OF CAP: ______

CONDITION OF JACKET: ______

ULTRASONIC READING:

ELEV: Under Jacket

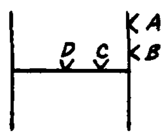



F. Alot of small pits

| A. | C. | E. | G. |
|---|---|---|---|
| 0.436 | 0.467 | 0.466 | 0.410 |
| .436 | .468 | .465 | .410 |
| .439 | .465 | .464 | .412 |
| .436 | .463 | .462 | .410 |
| .437 | .462 | .465 | .410 |
| .435 | .468 | .463 | .415 |
| .434 | .463 | .462 | .414 |
| .430 | .465 | .461 | .413 |
| Av. 0.435 | Av. 0.465 | Av. 0.464 | Av. 0.412 |

| B. | D. | F. |
|---|---|---|
| 0.485 | 0.488 | 0.480 |
| .485 | .487 | .480 |
| .484 | .485 | .481 |
| .482 | .488 | .481 |
| .482 | .488 | .478 |
| .481 | .488 | .486 |
| .483 | .489 | .487 |
| .485 | .481 | .481 |
| Av. 0.483 | Av. 0.487 | Av. 0.482 |

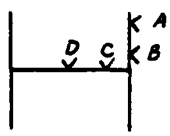
ELEV: -19




East Flange Alot of Large Pits

| A. | B. | C. | D. |
|---|---|---|---|
| 0.481 | 0.409 | 0.487 | 0.423 |
| .481 | .408 | .486 | .421 |
| .481 | .407 | .479 | .424 |
| .480 | .409 | .479 | .424 |
| .479 | .410 | .482 | .425 |
| .479 | .411 | .481 | .420 |
| .477 | .407 | .480 | .421 |
| .476 | .406 | .483 | .421 |
| Av. 0.479 | Av. 0.408 | Av. 0.482 | Av. 0.422 |

ELEV: -30'




| A. | B. | C. | D. |
|---|---|---|---|
| 0.368 | 0.387 | 0.459 | 0.429 |
| .365 | .386 | .459 | .427 |
| .368 | .384 | .457 | .425 |
| .368 | .384 | .458 | .426 |
| .365 | .383 | .458 | .429 |
| .365 | .387 | .460 | .430 |
| .364 | .388 | .460 | .428 |
| .360 | .388 | .455 | .427 |
| Av. 0.365 | Av. 0.386 | Av. 0.458 | Av. 0.428 |

COMMENTS, CALIBRATIONS: ______

GENERAL PIER CONDITION: ______

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

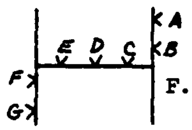
DATE: 8/2/79 BENT # 37 [XX] PLUMB [ ] BATTER PILE # F

CONDITION OF CAP:

CONDITION OF JACKET:

ULTRASONIC READING:

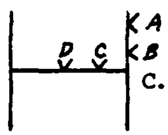
ELEV: Under Jacket




F. Very Deep Pits
Base of Pits
.200 - .250

| A. | B. | C. | D. | E. | F. | G. |
|---|---|---|---|---|---|---|
| 0.463 | 0.433 | 0.480 | 0.471 | 0.453 | 0.451 | 0.402 |
| .463 | .433 | .481 | .470 | .455 | .449 | .398 |
| .461 | .432 | .482 | .465 | .454 | .445 | .397 |
| .464 | .435 | .484 | .466 | .453 | .441 | .396 |
| .464 | .434 | .483 | .456 | .450 | .442 | .394 |
| .465 | .431 | .481 | .466 | .451 | .441 | .393 |
| .465 | .430 | .480 | .464 | .452 | .440 | .390 |
| .465 | .429 | .481 | .462 | .450 | .441 | .391 |
| Av. 0.464 | Av. 0.432 | Av. 0.482 | Av. 0.465 | Av. 0.452 | Av. 0.444 | Av. 0.395 |

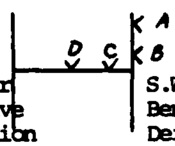
ELEV: -17'




C. Large Pit
.290 Center
of Pit

| A. | B. | C. | D. |
|---|---|---|---|
| 0.433 | 0.441 | 0.488 | 0.489 |
| .433 | .440 | .488 | .489 |
| .429 | .439 | .487 | .488 |
| .428 | .439 | .486 | .498 |
| .429 | .437 | .486 | .488 |
| .427 | .435 | .485 | .487 |
| .426 | .432 | .483 | .488 |
| .428 | .431 | .480 | .488 |
| Av. 0.429 | Av. 0.437 | Av. 0.485 | Av. 0.489 |

ELEV: -30'




.E. Corner
nt Concave
' Deflection

S.W. Corner
Bent Convex
Deflection

| A. | B. | C. | D. |
|---|---|---|---|
| 0.412 | 0.388 | 0.433 | 0.433 |
| .412 | .386 | .429 | .433 |
| .413 | .387 | .428 | .434 |
| .415 | .385 | .429 | .431 |
| .416 | .386 | .430 | .433 |
| .411 | .385 | .430 | .433 |
| .412 | .386 | .429 | .435 |
| .413 | .388 | .428 | .433 |
| Av. 0.413 | Av. 0.386 | Av. 0.430 | Av. 0.433 |

COMMENTS, CALIBRATIONS:

GENERAL PIER CONDITION:

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

DATE: 8/1/79 BENT # 37 [XX] PLUMB [ ] BATTER PILE # G

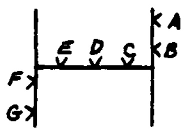
CONDITION OF CAP:

CONDITION OF JACKET:

ULTRASONIC READING:

ELEV: Under Jacket

A - Alot of Small Pits

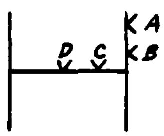



| A. | C. | E. | G. |
|---|---|---|---|
| 0.375 | 0.434 | 0.417 | 0.417 |
| .377 | .436 | .418 | .416 |
| .378 | .435 | .419 | .418 |
| .378 | .473 | .415 | .415 |
| .377 | .472 | .410 | .416 |
| .375 | .476 | .412 | .415 |
| .376 | .474 | .414 | .412 |
| .377 | .475 | .414 | .413 |
| Av. 0.377 | Av. 0.459 | Av. 0.415 | Av. 0.415 |
| **B.** | **D.** | **F.** | |
| 0.434 | 0.455 | 0.378 | |
| .435 | .452 | .379 | |
| .435 | .451 | .370 | |
| .436 | .449 | .381 | |
| .430 | .448 | .378 | |
| .432 | .451 | .379 | |
| .431 | .452 | .381 | |
| .429 | .449 | .379 | |
| Av. 0.433 | Av. 0.451 | Av. 0.378 | |

ELEV: -20'

Test Block = 0.488

B - Shallow Pit 2"x2" hole 1' above 20' Depth Flange S.E. Corner

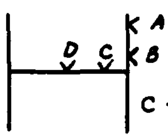



| A. | B. | C. | D. |
|---|---|---|---|
| 0.457 | 0.357 | 0.371 | 0.370 |
| .460 | .359 | .373 | .370 |
| .459 | .356 | .375 | .378 |
| .460 | .355 | .377 | .379 |
| .459 | .356 | .378 | .376 |
| .461 | .356 | .370 | .373 |
| .462 | .353 | .375 | .374 |
| .455 | .354 | .377 | .373 |
| Av. 0.459 | Av. 0.356 | Av. 0.375 | Av. 0.374 |

ELEV: -35'

D - Shallow Pits

C - Shallow Pits




| A. | B. | C. | D. |
|---|---|---|---|
| 0.477 | 0.473 | 0.396 | 0.382 |
| .478 | .473 | .396 | .382 |
| .478 | .472 | .395 | .380 |
| .471 | .476 | .393 | .381 |
| .478 | .479 | .403 | .385 |
| .477 | .473 | .401 | .386 |
| .477 | .481 | .406 | .385 |
| .478 | .470 | .398 | .381 |
| Av. 0.477 | Av. 0.475 | Av. 0.399 | Av. 0.383 |

COMMENTS, CALIBRATIONS:

GENERAL PIER CONDITION:

**WISWELL, INC.**

**U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA**

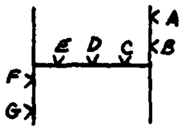
DATE: 8/1/79 BENT # 40 [XX] PLUMB [ ] BATTER PILE # A

CONDITION OF CAP:

CONDITION OF JACKET:

ULTRASONIC READING:

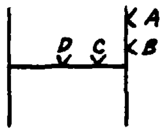
ELEV: Under Jacket




Area where jacket was removed thickness in Pits .30-.34 Around Pits .42-.47

| | A. | B. | C. | D. | E. | F. | G. |
|---|---|---|---|---|---|---|---|
| | 0.430 | 0.389 | 0.443 | 0.464 | 0.481 | 0.378 | 0.467 |
| | .431 | .387 | .442 | .463 | .482 | .376 | .466 |
| | .432 | .387 | .441 | .462 | .480 | .372 | .465 |
| | .431 | .388 | .442 | .461 | .481 | .376 | .466 |
| | .433 | .387 | .442 | .463 | .480 | .377 | .465 |
| | .434 | .389 | .442 | .464 | .482 | .375 | .464 |
| | .435 | .386 | .445 | .464 | .480 | .379 | .465 |
| | .437 | .384 | .444 | .461 | .481 | .375 | .467 |
| Av. | 0.433 | 0.387 | 0.443 | 0.463 | 0.481 | 0.376 | 0.466 |

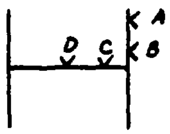
ELEV: -18'




C - Readings in a pit

| | A. | B. | C. | D. |
|---|---|---|---|---|
| | 0.473 | 0.433 | 0.375 | 0.363 |
| | .472 | .432 | .374 | .362 |
| | .473 | .438 | .372 | .361 |
| | .471 | .437 | .374 | .367 |
| | .471 | .437 | .372 | .364 |
| | .474 | .436 | .373 | .365 |
| | .475 | .439 | .372 | .367 |
| | .473 | .431 | .371 | .362 |
| Av. | 0.473 | 0.435 | 0.373 | 0.364 |

ELEV: -30'




| | A. | B. | C. | D. |
|---|---|---|---|---|
| | 0.449 | 0.431 | 0.458 | 0.448 |
| | .450 | .432 | .457 | .447 |
| | .451 | .432 | .459 | .448 |
| | .450 | .435 | .461 | .446 |
| | .448 | .437 | .457 | .447 |
| | .452 | .431 | .462 | .450 |
| | .454 | .434 | .460 | .451 |
| | .451 | .432 | .461 | .449 |
| Av. | 0.451 | 0.433 | 0.459 | 0.448 |

COMMENTS, CALIBRATIONS:

GENERAL PIER CONDITION:

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

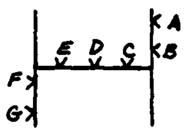
DATE: 8/1/79 BENT # 40 [XX] PLUMB [ ] BATTER PILE # B

CONDITION OF CAP:

CONDITION OF JACKET:

ULTRASONIC READING:

ELEV: Under Jacket



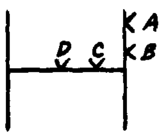

A lot of Small Pits

2"x2" hole Edge of Flange

| A. | C. | E. | G. |
|---|---|---|---|
| 0.422 | 0.380 | 0.420 | 0.418 |
| .418 | .380 | .419 | .418 |
| .420 | .380 | .427 | .417 |
| .423 | .381 | .418 | .419 |
| .422 | .383 | .419 | .420 |
| .422 | .383 | .418 | .421 |
| .423 | .384 | .418 | .420 |
| .424 | .382 | .417 | .421 |
| Av. 0.422 | Av. 0.382 | Av. 0.420 | Av. 0.419 |

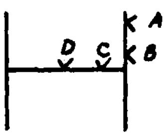
| B. | D. | F. |
|---|---|---|
| 0.320 | 0.402 | 0.429 |
| .321 | .403 | .423 |
| .317 | .404 | .431 |
| .322 | .404 | .431 |
| .321 | .405 | .432 |
| .322 | .405 | .433 |
| .323 | .403 | .431 |
| .322 | .401 | .431 |
| Av. 0.321 | Av. 0.403 | Av. 0.430 |

ELEV: -18'




| A. | B. | C. | D. |
|---|---|---|---|
| 0.457 | 0.480 | 0.450 | 0.441 |
| .456 | .481 | .451 | .441 |
| .457 | .484 | .449 | .441 |
| .457 | .483 | .449 | .444 |
| .457 | .481 | .451 | .439 |
| .456 | .479 | .450 | .440 |
| .478 | .479 | .451 | .439 |
| .457 | .477 | .446 | .438 |
| Av. 0.459 | Av. 0.480 | Av. 0.450 | Av. 0.440 |

ELEV: -29'




| A. | B. | C. | D. |
|---|---|---|---|
| 0.362 | 0.382 | 0.442 | 0.457 |
| .362 | .382 | .441 | .454 |
| .361 | .381 | .442 | .454 |
| .360 | .380 | .440 | .455 |
| .361 | .381 | .442 | .453 |
| .362 | .381 | .444 | .452 |
| .359 | .380 | .443 | .452 |
| .356 | .382 | .443 | .451 |
| Av. 0.361 | Av. 0.381 | Av. 0.442 | Av. 0.454 |

COMMENTS, CALIBRATIONS:

GENERAL PIER CONDITION:

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

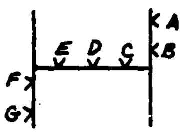
DATE: 8/1/79 BENT # 40 [XX] PLUMB [ ] BATTER PILE # C

CONDITION OF CAP: ______________________

CONDITION OF JACKET: ______________________

ULTRASONIC READING:

ELEV: Under Jacket



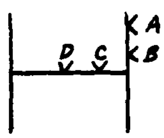

B - Pit Behind Area

E - Hole Each side Flange

| A. | C. | E. | G. |
|---|---|---|---|
| 0.399 | 0.467 | 0.473 | 0.404 |
| .399 | .467 | .475 | .403 |
| .395 | .460 | .474 | .406 |
| .398 | .460 | .478 | .405 |
| .398 | .459 | .475 | .407 |
| .396 | .459 | .474 | .405 |
| .397 | .460 | .476 | .408 |
| .398 | .462 | .482 | .408 |
| Av. 0.398 | Av. 0.462 | Av. 0.476 | Av. 0.406 |

| B. | D. | F. |
|---|---|---|
| 0.166 | 0.425 | 0.411 |
| .166 | .425 | .411 |
| .167 | .418 | .411 |
| .169 | .418 | .410 |
| .170 | .425 | .411 |
| .167 | .402 | .410 |
| .169 | .402 | .410 |
| .166 | .422 | .411 |
| Av. 0.168 | Av. 0.417 | Av. 0.410 |

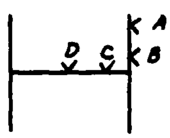
ELEV: -19'




Slight Loss of Flange Area (D.W.)

| A. | B. | C. | D. |
|---|---|---|---|
| 0.343 | 0.161 | 0.435 | 0.406 |
| .341 | .167 | .437 | .407 |
| .345 | .169 | .437 | .408 |
| .347 | .173 | .446 | .407 |
| .346 | .166 | .425 | .407 |
| .347 | .166 | .429 | .408 |
| .346 | .176 | .427 | .410 |
| .345 | .169 | .428 | .410 |
| Av. 0.345 | Av. 0.168 | Av. 0.433 | Av. 0.408 |

ELEV: -28' M.L.




D - Hole in web area 1"x1"

| A. | B. | C. | D. |
|---|---|---|---|
| 0.474 | 0.422 | 0.433 | 0.373 |
| .474 | .426 | .433 | .375 |
| .475 | .427 | .436 | .376 |
| .473 | .429 | .433 | .373 |
| .474 | .422 | .435 | .377 |
| .479 | .424 | .434 | .376 |
| .476 | .429 | .433 | .375 |
| .474 | .428 | .434 | .374 |
| Av. 0.475 | Av. 0.425 | Av. 0.434 | Av. 0.375 |

COMMENTS, CALIBRATIONS: ______________________

GENERAL PIER CONDITION: ______________________

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

DATE: 8/1/79 BENT # 40 [XX] PLUMB [ ] BATTER PILE # D

CONDITION OF CAP: ______

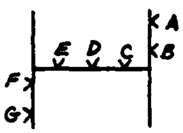
CONDITION OF JACKET: ______

ULTRASONIC READING:

ELEV: Under Jacket

E - slight pitting .25 deep

B - long pit .30 deep

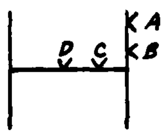



| A. | C. | E. | G. |
|---|---|---|---|
| 0.419 | 0.461 | 0.370 | 0.487 |
| .420 | .460 | .370 | .487 |
| .425 | .459 | .376 | .488 |
| .409 | .460 | .369 | .488 |
| .410 | .465 | .370 | .480 |
| .418 | .469 | .367 | .480 |
| .422 | .465 | .366 | .481 |
| .424 | .462 | .366 | .485 |
| Av. 0.418 | Av. 0.463 | Av. 0.370 | Av. 0.485 |

| B. | D. | F. |
|---|---|---|
| 0.455 | 0.441 | 0.473 |
| .452 | .440 | .473 |
| .451 | .434 | .473 |
| .454 | .435 | .472 |
| .453 | .436 | .470 |
| .451 | .440 | .471 |
| .457 | .441 | .473 |
| | .437 | .472 |
| Av. 0.453 | Av. 0.439 | Av. 0.472 |

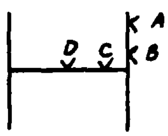
ELEV: -19

B - small pits




| A. | B. | C. | D. |
|---|---|---|---|
| 0.426 | 0.449 | 0.388 | 0.470 |
| .426 | .448 | .389 | .470 |
| .425 | .447 | .394 | .469 |
| .429 | .449 | .391 | .468 |
| .421 | .457 | .388 | .463 |
| .420 | .456 | .394 | .457 |
| .419 | .455 | .393 | .460 |
| .419 | .454 | .393 | .465 |
| Av. 0.423 | Av. 0.452 | Av. 0.391 | Av. 0.465 |

ELEV: -28 ML




| A. | B. | C. | D. |
|---|---|---|---|
| 0.449 | 0.465 | 0.386 | 0.473 |
| .449 | .463 | .386 | .472 |
| .471 | .461 | .388 | .471 |
| .473 | .463 | .389 | .477 |
| .469 | .461 | .394 | .471 |
| .468 | .464 | .385 | .471 |
| .470 | .462 | .387 | .470 |
| .472 | .465 | .384 | .471 |
| Av. 0.465 | Av. 0.463 | Av. 0.387 | Av. 0.472 |

COMMENTS, CALIBRATIONS: ______

GENERAL PIER CONDITION: ______

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

DATE: 8/1/79  BENT # 40  [XX] PLUMB  [ ] BATTER  PILE # E

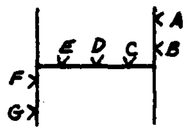
CONDITION OF CAP:

CONDITION OF JACKET:

ULTRASONIC READING:

ELEV: Under Jacket  A*

F - All small pits hard to get good readings

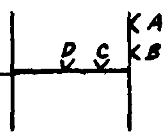



| A. | C. | E. | G. |
|---|---|---|---|
| 0.416 | 0.473 | 0.480 | 0.408 |
| .414 | .473 | .481 | .409 |
| .411 | .476 | .475 | .402 |
| .416 | .478 | .471 | .411 |
| .421 | .480 | .474 | .402 |
| .415 | .477 | .475 | .400 |
| .414 | .475 | .481 | .399 |
| .414 | .473 | .483 | .403 |
| Av. 0.415 | Av. 0.476 | Av. 0.478 | Av. 0.404 |

| B. | D. | F. |
|---|---|---|
| 0.488 | 0.473 | 0.386 |
| .478 | .474 | .386 |
| .489 | .473 | .385 |
| .480 | .475 | .380 |
| .482 | .474 | .380 |
| .476 | .475 | .386 |
| .480 | .476 | .384 |
| .484 | .478 | .383 |
| Av. 0.482 | Av. 0.478 | Av. 0.384 |

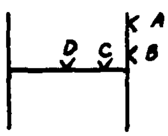
ELEV: -20'

B - Small pits




| A. | B. | C. | D. |
|---|---|---|---|
| 0.424 | 0.466 | 0.425 | 0.428 |
| .425 | .465 | .425 | .426 |
| .428 | .467 | .427 | .429 |
| .427 | .472 | .433 | .430 |
| .424 | .470 | .433 | .432 |
| .427 | .466 | .426 | .426 |
| .428 | .465 | .421 | .433 |
| .432 | .468 | .418 | .431 |
| Av. 0.427 | Av. 0.467 | Av. 0.426 | Av. 0.429 |

ELEV: -30




| A. | B. | C. | D. |
|---|---|---|---|
| 0.479 | 0.358 | 0.402 | 0.375 |
| .478 | .359 | .402 | .379 |
| .488 | .356 | .398 | .380 |
| .488 | .355 | .399 | .378 |
| .483 | .356 | .410 | .375 |
| .488 | .357 | .412 | .379 |
| .484 | .355 | .402 | .401 |
| .486 | .356 | | |
| Av. 0.484 | Av. 0.357 | Av. 0.404 | Av. 0.381 |

COMMENTS, CALIBRATIONS: #1 .487, .488 / #2 .488 Test Block

GENERAL PIER CONDITION: A* 6" indent in flange 1 1/2" deep plus large pit

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

DATE: 8/1/79 BENT # 40 [XX] PLUMB [ ] BATTER PILE # F

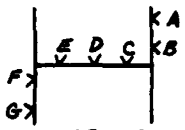
CONDITION OF CAP:

CONDITION OF JACKET:

ULTRASONIC READING:

ELEV: Under Jacket

C - Thickness in pit .37
Beside pit .42

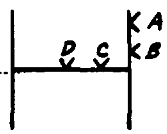



| A.* | C** | E. | G. |
|---|---|---|---|
| 0.407 | 0.423 | 0.353 | 0.421 |
| .409 | .425 | .352 | .423 |
| .422 | .424 | .350 | .433 |
| .411 | .418 | .351 | .430 |
| .418 | .418 | .355 | .425 |
| .410 | .417 | .360 | .419 |
| .411 | .411 | .351 | .417 |
| | .414 | .346 | .424 |
| Av. 0.412 | Av. 0.419 | Av. 0.352 | Av. 0.424 |

| B. | D. | F*** |
|---|---|---|
| 0.457 | 0.410 | 0.428 |
| .462 | .411 | .429 |
| .463 | .401 | .430 |
| .464 | .402 | .433 |
| .457 | .402 | .425 |
| .463 | .400 | .424 |
| .457 | .402 | .426 |
| .466 | .411 | .429 |
| Av. 0.461 | Av. 0.405 | Av. 0.428 |

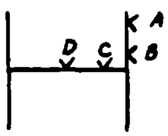
*Severe knife edge - knife edge into flange 2 1/2"
**Large pit
***Regular pitting

ELEV: -21




| A. | B. | C. | D. |
|---|---|---|---|
| 0.425 | 0.480 | 0.448 | 0.439 |
| .425 | .480 | .449 | .438 |
| .430 | .481 | .450 | .440 |
| .437 | .477 | .457 | .441 |
| .432 | .480 | .462 | .439 |
| .433 | .473 | .459 | .448 |
| .430 | .476 | .467 | .440 |
| .429 | .480 | .487 | .447 |
| AV. 0.430 | AV. 0.478 | AV. 0.460 | AV. 0.442 |

ELEV: -33




| A. | B. | C. | D. |
|---|---|---|---|
| 0.473 | 0.458 | 0.488 | 0.470 |
| .474 | .453 | .488 | .471 |
| .470 | .459 | .489 | .479 |
| .475 | .457 | .487 | .485 |
| .465 | .465 | .468 | .478 |
| .468 | .465 | .470 | .473 |
| .465 | .460 | .470 | .473 |
| .472 | .463 | .473 | .476 |
| AV. 0.470 | AV. 0.460 | AV. 0.480 | AV. 0.476 |

COMMENTS, CALIBRATIONS:

GENERAL PIER CONDITION:

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

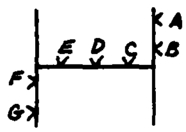
DATE: 8/1/79  BENT # 40  [XX] PLUMB  [ ] BATTER  PILE # G

CONDITION OF CAP:

CONDITION OF JACKET:

ULTRASONIC READING:

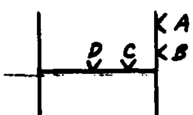
ELEV: Under Cap




| A. | C. | E. | G. |
|---|---|---|---|
| 0.482 | 0.453 | 0.466 | 0.496 |
| .473 | .459 | .465 | .497 |
| .488 | .460 | .462 | .499 |
| .498 | .462 | .459 | .496 |
| .488 | .463 | .458 | .477 |
| .496 | .458 | .458 | .478 |
| .489 | .458 | .452 | .474 |
| | | .458 | .476 |
| Av. 0.488 | Av. 0.459 | Av. 0.460 | Av. 0.488 |

| B. | D. | F. |
|---|---|---|
| 0.475 | 0.418 | 0.485 |
| .477 | .419 | .487 |
| .480 | .422 | .483 |
| .478 | .418 | .484 |
| .476 | .417 | .485 |
| .486 | .419 | .486 |
| .477 | .420 | .494 |
| | .417 | |
| Av. 0.479 | Av. 0.419 | Av. 0.486 |

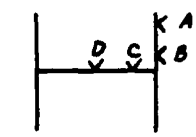
ELEV: -20




*Flange deformation 3" inward bent is at reading "B"

| A.* | B. | C. | D. |
|---|---|---|---|
| 0.431 | 0.367 | 0.346 | 0.466 |
| .433 | .361 | .351 | .465 |
| .426 | .367 | .354 | .471 |
| .430 | .356 | .351 | .473 |
| .429 | .355 | .349 | .472 |
| .424 | .367 | .347 | .481 |
| .433 | .364 | .347 | .477 |
| .431 | .346 | .351 | .469 |
| Av. 0.430 | Av. 0.360 | Av. 0.349 | Av. 0.471 |

ELEV: -33




| A. | B. | C. | D. |
|---|---|---|---|
| 0.473 | 0.481 | 0.449 | 0.473 |
| .473 | .485 | .446 | .473 |
| .481 | .485 | .451 | .472 |
| .481 | .486 | .457 | .475 |
| .482 | .488 | .449 | .465 |
| .478 | .482 | .431 | .477 |
| .480 | .480 | .445 | .471 |
| .479 | .481 | .457 | .472 |
| Av. 0.478 | Av. 0.484 | Av. 0.448 | Av. 0.472 |

COMMENTS, CALIBRATIONS:

Topside 199-200 internal test block

GENERAL PIER CONDITION:

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

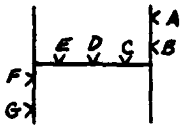
DATE: 8/2/79 BENT # 79 [XX] PLUMB [ ] BATTER PILE # F

CONDITION OF CAP:

CONDITION OF JACKET:

ULTRASONIC READING:

ELEV: Under Jacket



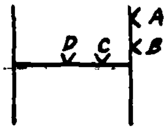
D - Large Pit .330 deep 2"x3"

G - Large Pit .296 deep 1" x 2 1/2"

| A. | C. | E. | G. |
|---|---|---|---|
| 0.459 | 0.450 | 0.481 | 0.355 |
| .460 | .450 | .487 | .355 |
| .462 | .452 | .484 | .354 |
| .468 | .451 | .488 | .356 |
| .469 | .449 | .486 | .352 |
| .466 | .450 | .489 | .351 |
| .464 | .453 | .488 | .352 |
| .460 | .452 | .488 | .350 |
| Av. 0.464 | Av. 0.451 | Av. 0.486 | Av. 0.353 |

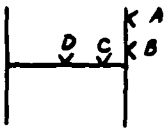
| B. | D. | F. |
|---|---|---|
| 0.427 | 0.457 | 0.481 |
| .429 | .458 | .481 |
| .421 | .462 | .482 |
| .422 | .458 | .480 |
| .428 | .452 | .479 |
| .429 | .452 | .476 |
| .430 | .451 | .475 |
| .430 | .450 | .474 |
| Av. 0.427 | Av. 0.455 | Av. 0.479 |

ELEV: -15'



| A. | B. | C. | D. |
|---|---|---|---|
| 0.457 | 0.324 | 0.440 | 0.447 |
| .458 | .325 | .437 | .440 |
| .459 | .323 | .439 | .439 |
| .458 | .322 | .436 | .437 |
| .462 | .321 | .433 | .436 |
| .458 | .320 | .431 | .443 |
| .458 | .322 | .430 | .442 |
| .454 | .321 | .431 | .441 |
| Av. 0.458 | Av. 0.322 | Av. 0.435 | Av. 0.441 |

ELEV: -31'



B - Pit

C - Pit

D - Large Pit

| A. | B. | C. | D. |
|---|---|---|---|
| 0.488 | 0.339 | 0.316 | 0.452 |
| .488 | .332 | .307 | .449 |
| .489 | .330 | .303 | .448 |
| .489 | .331 | .310 | .446 |
| .490 | .332 | .309 | .437 |
| .491 | .334 | .307 | .434 |
| .491 | .331 | .308 | .434 |
| .491 | .332 | .301 | .432 |
| Av. 0.490 | Av. 0.333 | Av. 0.308 | Av. 0.442 |

COMMENTS, CALIBRATIONS:

GENERAL PIER CONDITION:

WISWELL, INC.

U.S. NAVAL BASE GUANTANAMO BAY, CUBA, PIER LIMA

DATE: 8/2/79 BENT # 79 [XX] PLUMB [ ] BATTER PILE # G

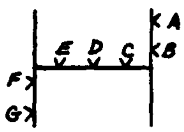
CONDITION OF CAP:

CONDITION OF JACKET:

ULTRASONIC READING:

ELEV: Under Jacket Cal. .488

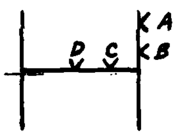
F - Pits
.240 inside




| A. | C. | E. | G. |
|---|---|---|---|
| 0.457 | 0.394 | 0.449 | 0.441 |
| .454 | .394 | .449 | .440 |
| .453 | .395 | .448 | .444 |
| .453 | .394 | .447 | .441 |
| .453 | .395 | .442 | .413 |
| .458 | .397 | .440 | .413 |
| .457 | .396 | .448 | .412 |
| .456 | .397 | .442 | .411 |
| Av. 0.455 | Av. 0.395 | Av. 0.446 | Av. 0.427 |

| B. | D. | F. |
|---|---|---|
| 0.481 | 0.410 | 0.369 |
| .483 | .410 | .369 |
| .481 | .411 | .366 |
| .480 | .410 | .369 |
| .479 | .419 | .368 |
| .484 | .420 | .362 |
| .483 | .408 | .370 |
| .487 | .406 | .369 |
| Av. 0.482 | Av. 0.412 | Av. 0.368 |

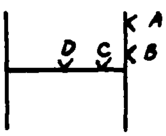
ELEV: -17'




C - Large Pit
.184 inside
3"x4"

| A. | B. | C. | D. |
|---|---|---|---|
| 0.460 | 0.388 | 0.452 | 0.391 |
| .463 | .389 | .449 | .392 |
| .465 | .389 | .449 | .394 |
| .460 | .387 | .455 | .390 |
| .460 | .386 | .450 | .392 |
| .459 | .378 | .457 | .394 |
| .457 | .377 | .449 | .394 |
| .457 | .377 | .447 | .391 |
| Av. 0.460 | Av. 0.384 | Av. 0.451 | Av. 0.392 |

ELEV: -35'




| A. | B. | C. | D. |
|---|---|---|---|
| 0.394 | 0.447 | 0.463 | 0.446 |
| .396 | .449 | .464 | .449 |
| .393 | .450 | .465 | .447 |
| .397 | .453 | .467 | .442 |
| .399 | .452 | .464 | .447 |
| .392 | .452 | .463 | .442 |
| .391 | .453 | .465 | .440 |
| .390 | .454 | .466 | .441 |
| Av. 0.394 | Av. 0.451 | Av. 0.451 | Av. 0.444 |

COMMENTS, CALIBRATIONS:

GENERAL PIER CONDITION:

APPENDIX V

PIER LIMA
NAVAL STATION, GUANTANAMO BAY, CUBA

GOVERNMENT FURNISHED INFORMATION

GOVERNMENT FURNISHED INFORMATION

| | |
|---|---|
| Yards & Docks Drawing #336505 | Ship Repair Project, General Plan (1943) |
| Yards & Docks Drawing #470806 | Rehabilitation of Repair Pier Lima, General Plan (1950) |
| Yards & Docks Drawing #470807 | Rehabilitation of Repair Pier Lima, Typical Details-Outboard End |
| Yards & Docks Drawing #470808 | Rehabilitation of Repair Pier Lima, Typical Details-Inboard End |

| | |
|---|---|
| NAVFAC Drawing #4001966 | Repair Pier Lima--Maps, Plan & Section |
| NAVFAC Drawing #4001967 | Repair Pier Lima--Part Plan |
| NAVFAC Drawing #4001968 | Repair Pier Lima--Part Plan & Notes |
| NAVFAC Drawing #4001969 | Repair Pier Lima--Part Plan & Details |
| NAVFAC Drawing #4001970 | Repair Pier Lima--Fender System & Pile Details |
| NAVFAC Drawing #4001971 | Repair Pier Lima--Details & Sections |
| NAVFAC Drawing #4001972 | Repair Pier Lima--Details & Sections |
| NAVFAC Drawing #4001973 | Repair Pier Lima--Plan Legend & Details Electrical |
| NAVFAC Drawing #4001974 | Repair Pier Lima--Part Plan-Pier Electrical |

"Point Paper on the Preliminary Underwater Survey of Pier Lima, Guantanamo Bay, Cuba" by Jack E. Baber (July 1979)

APPENDIX VI

PIER LIMA
NAVAL STATION, GUANTANAMO BAY, CUBA

PETROGRAPHIC EXAMINATION FINDINGS
as conducted by
Construction Technology Laboratories

construction technology laboratories

A Division of the PORTLAND CEMENT ASSOCIATION

5420 Old Orchard Road Skokie Illinois 60077 • Area Code 312 966-6200

September 6, 1979

Mr. George C. Wiswell, Jr.
President
Wiswell, Inc.
3280 Post Road
Southport, Connecticut 06490

Mr. Wiswell:

Attached is a report by D. H. Campbell giving results of petrographic examination of a large concrete sample transmitted by your letter of August 8.

We believe the report is complete and self-explanatory; however, if you have any questions or if we can be of further assistance, do not hestitate to contact us.

In keeping with our policy, we will retain your sample for a period of one year, at which time it will be discarded unless we receive word from you to the contrary.

Sincerely yours,

J. J. Shideler, Director
Administrative and Technical Services

JJS/lg
CT-0616

Copy to -
W. E. Kunze
E. Hognestad
D. C. Sikes
D. H. Campbell

Attachment

## Petrographic Services Report

Project No.: CT-0616 Date: September 4, 1979

Re: Deteriorated H-piling
(Wiswell, Inc.)

A large concrete sample, weighing approximately 50 pounds reportedly taken from an H-piling (BP14-73) in the tidal zone of a U.S. Navy installation, has been received from Wiswell, Inc., Southport, Connecticut, for petrographic examination relating to extensive deterioration.

### Conclusions

The concrete is of extremely low quality, having a weak paste-aggregate bond. Evidence of extensive paste alteration is present.

### Methods

Procedures for petrographic (microscopic) examination are detailed in ASTM C-856, "Petrographic Examination of Hardened Concrete."

### Description and Discussion

An attempt to saw a slice from the concrete sample was only moderately successful. The paste is extremely soft and was severely eroded during the sawing operation and, consequently, could not be lapped.

Nevertheless, the sawed slice did reveal segregation of coarse aggregates (Photo 1), a natural gravel composed mainly of meta-quartzite, limestone, chert, and a few other sedimentary rock types. Aggregate top size is approximately 1/2 to 3/4 inch. The metaquartzite may be potentially alkali-reactive, but clear evidence of the reaction was not observed.

Fine aggregate is a natural sand composed of ordinary quartz, metaquartzite, chert, feldspar, and other minerals and rock fragments. Coarse to fine aggregate ratio is about 55/45. Paste-aggregate bond is extremely weak.

The soft cream-colored paste contains very few unhydrated portland cement clinker particles. Calcium hydroxide is scarce. Ettringite, a hydrated calcium sulfo-aluminate, is common as needle-like crystals on crack surfaces and within the paste. Carbonation of the paste on freshly cut surfaces is rapid in the laboratory atmosphere. The paste has a dull luster. These

data suggest a high water-cement ratio, although this interpretation is questionable because of the apparent deterioration of the paste. Other secondary alteration products detected by X-ray diffraction are brucite and chloro-aluminate hydrate, which are common products of sea-water attack. The concrete is not air-entrained. Wire mesh is severely corroded.

D. H. Campbell (lg)

D. H. Campbell, Supervisor
Petrographic Services
Technical Services Section

DHC/md
CT-0616

Copy to-
J. J. Shideler

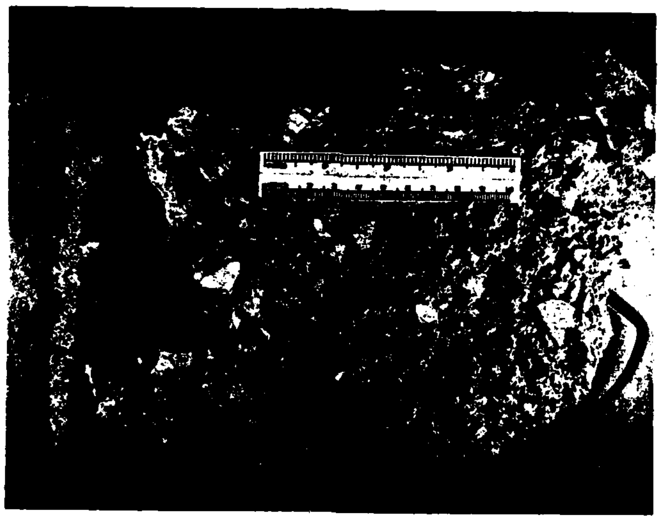


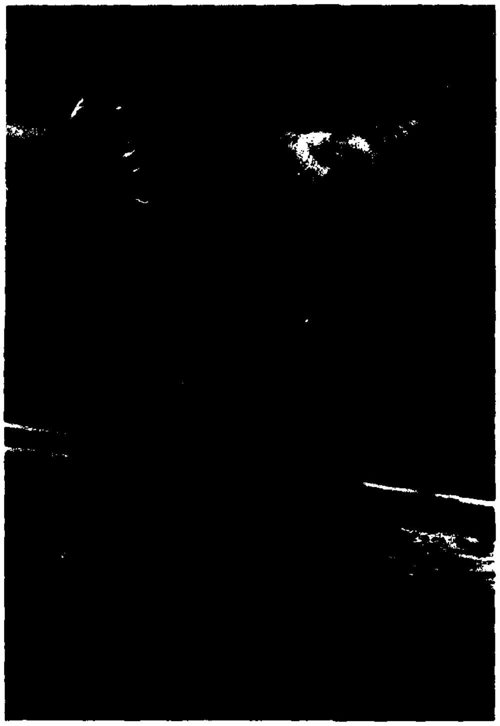
Photo 1 -- Sawed slice showing extreme paste erosion and demonstrating the low strength of the material.

CT-0616

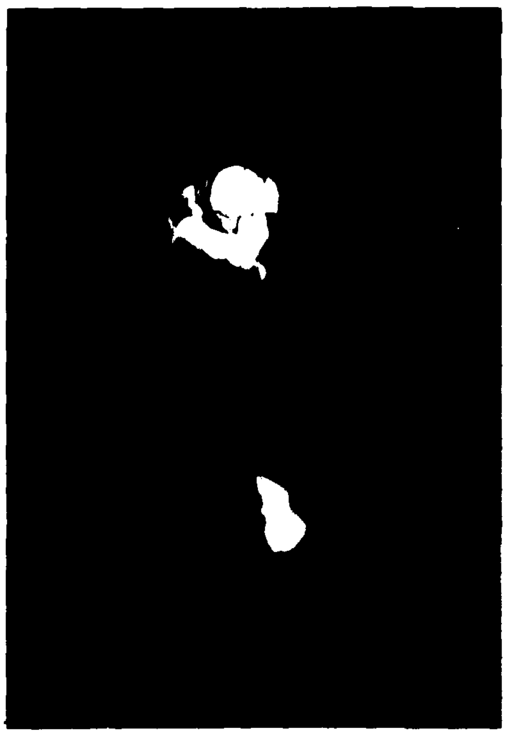
APPENDIX VII

PIER LIMA
NAVAL STATION, GUANTANAMO BAY, CUBA

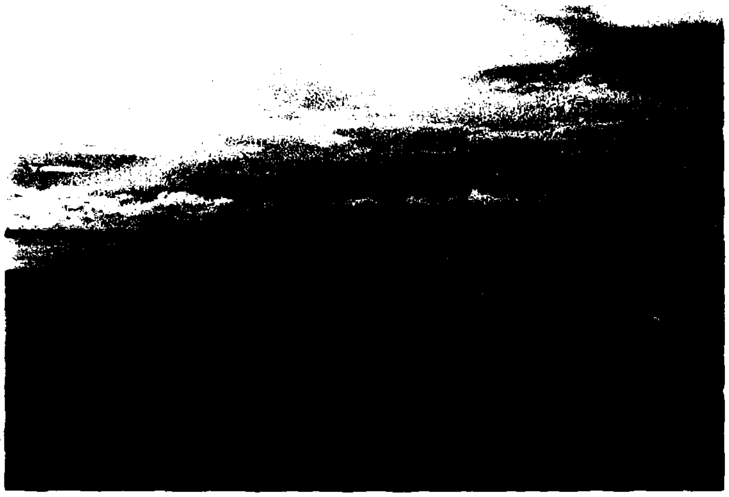
PHOTOGRAPHS



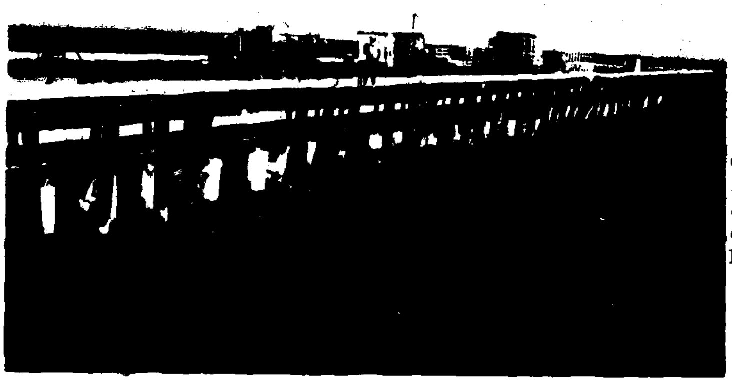
1. Two of the three man Wiswell, Inc. engineer/diver inspection team with dive station in background.



2. Getting to work.



3. View looking in a southerly direction straight out on Pier Lima.

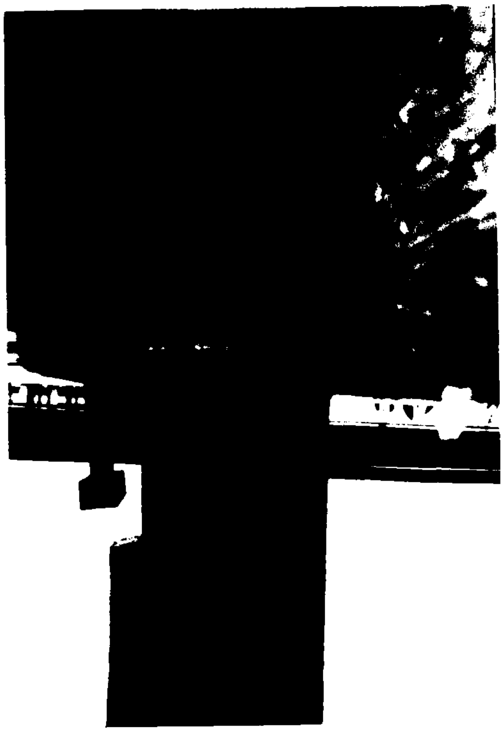


4. View of G Row of Pier Lima taken from west side access ramp with dive station at Bent #30.

5. Even closer view of G Row showing Bents #20 to #26.

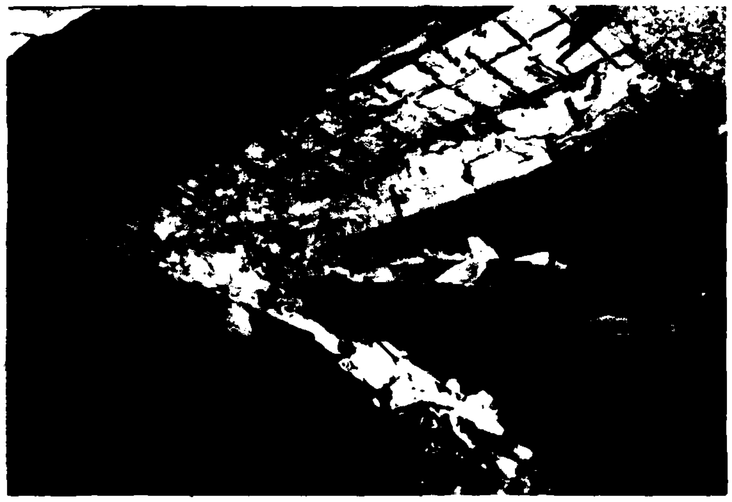
6. View of A Row looking shoreward from near outboard end.

7. Typical pile cap damage near outer end of pier, A Row.



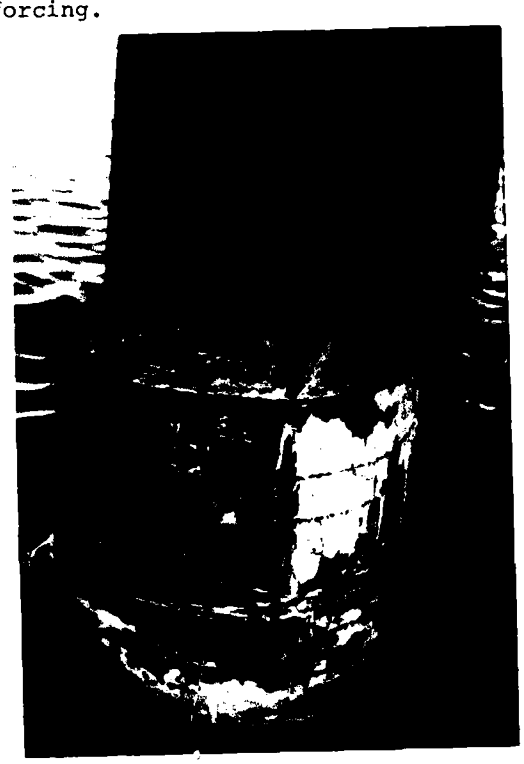
8. Bent #37, Pile F - note 6" x 16" piece pulled away from main 12" x 16" timber pile cap. Note improper bearing of pile cap to pile. Inspection revealed that there were 3 bolt holes over Pile F and only 1 bolt in place and 4 bolt holes over Pile G and only 1 bolt in place.


9. Separated joint on west access ramp. Picture taken in a westerly direction.

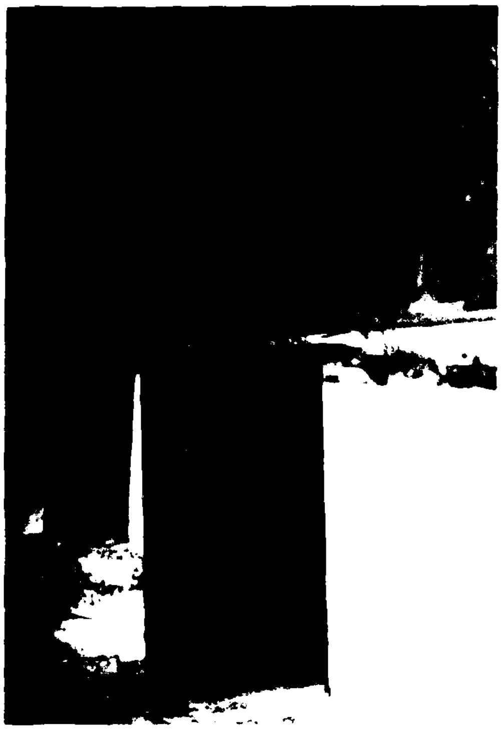


10. Section between Bents #15 and #16 showing typical failed old deck. Note spalled concrete and deteriorated reinforcing.

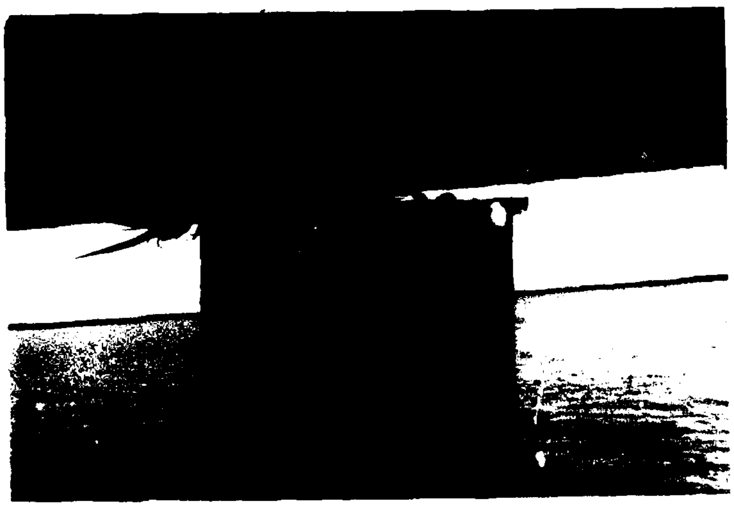
11. Angular view over the edge, showing cracks radiating outwards from each of the flanges.



12. Bent #77, Pile F--no concrete over both right-hand flanges.



13. Bent #81, Pile F--no contact with cap.



14. Bent #81, Pile G--angular contact with cap. Not full bearing. Also typical loose bolt.

15. Batter pile between Bents #71 and #72, G Row, indicating minimal cover on one side.

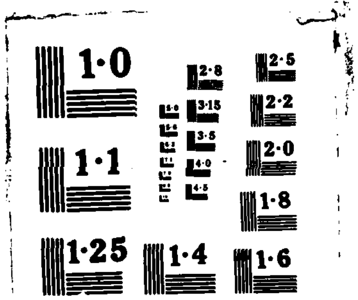
16. Batter pile between Bents #67 and #68, G Row, showing minimal cover of concrete jacket, plus inadequate structural transfer of load across splice. Note unusual combination of bolt types used.


17. Bent #44, (not 45) Pile G--approximately 10 percent bearing between top of pile and pile cap. Note concrete on top of pile plate, doubtless from the time deck was resurfaced.

18. Batter between Bents #37 & #38 with a section of the flange removed to allow the pipe to pass. Also non-alignment of upper and lower batter. Improper splice design and improper bolting.

AD-A167 632 REPORT AND RECOMMENDATIONS ON UNDERWATER DAMAGE ASSESSMENT PIER LIMA NAVA.. (U) MITRE CORP MCLEAN VA JASON PROGRAM OFFICE SEP 79 CHES/NAVFAC-FPO-7914 2/2

UNCLASSIFIED N62477-79-C-0837 F/G 13/2 NL


1·0
2·8
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1·1
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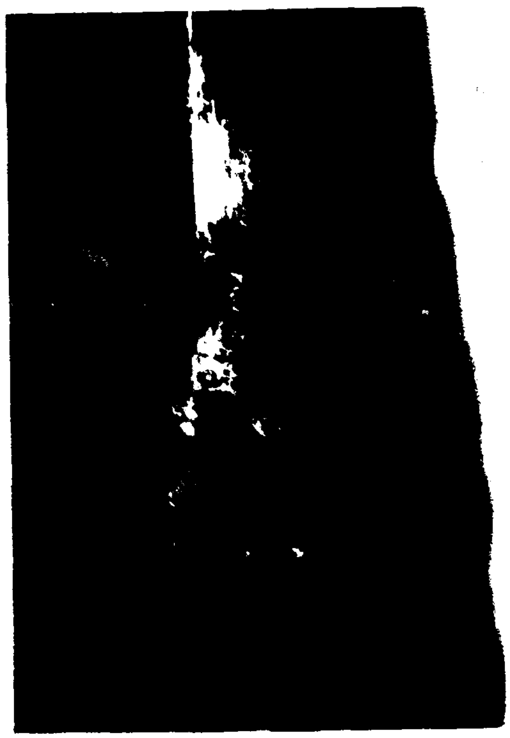
1·6

19. Bent #57, Pile F--decreasing width as a result of delamination and corrosive action.

20. Bent #55, Pile F--typical corner split referred to in text. Generally speaking as a result of improper concrete coverage and resulting oxidation.

21. Bent #47, Pile F--top of typical old jacket showing corroded, reinforcing, deterioration & lack of concentricity.

22. Example of improperly filled form coupled with lack of concentricity.

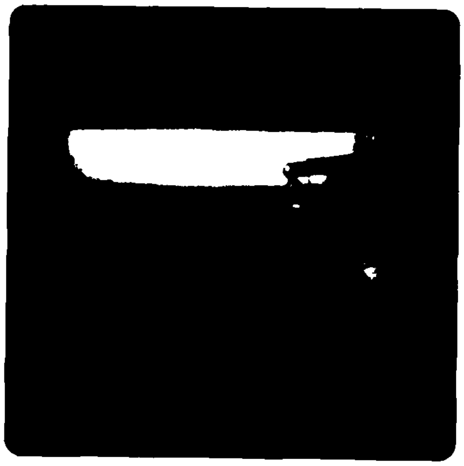


23. Fender pile destroyed by limnoria at waterline.

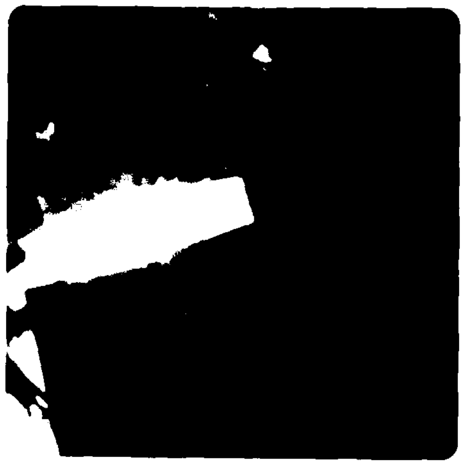
24. Example of spalling adjacent to flange edge.

25. Close up view of 90 pound concrete sample removed from lower underwater portion of jacket on Bent #40, Row A. Note oxidation streaks as well as apparent voids in concrete. Note two deteriorated reinforcing rods coming from top.

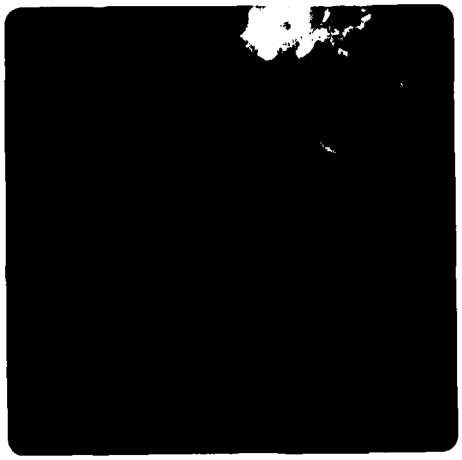
26. Close up under jacket showing decreasing width of two flanges.



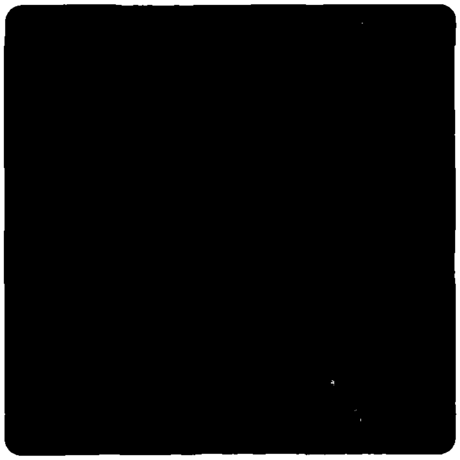
27. Pile on Bent #16, Row F, immediately under the cap showing some of the tools used in measuring. Also the picture clearly shows flange width being 0.310".



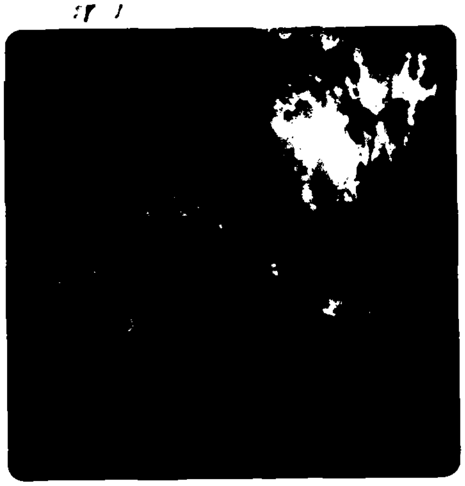
28. Cleaned & uncleaned area on pile on Bent #15, Row G, indicating the typical amount of bio-fouling at elevation immediately under cap and occasionally at mid-depth. Growth is of harder consistency at mudline than is pictured in this photograph.



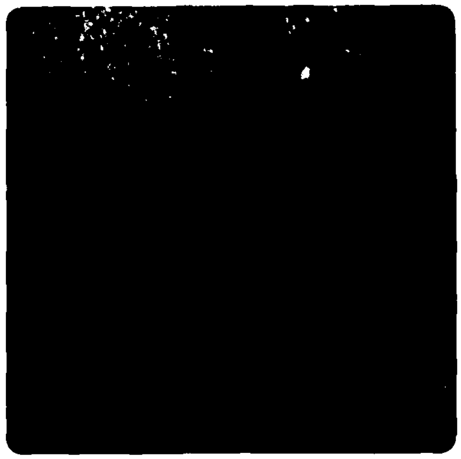
29. View looking upwards, Bent #40, Row A, showing remains of old concrete jacket. This is section where concrete sample shown in photograph #25 was removed. Note knife edging of flange, decreasing width, and corrosion streak through concrete in line with edge of flange.



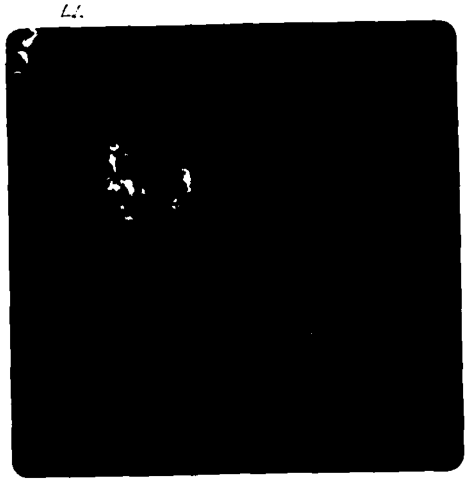
30. View looking upwards on Bent #40, Row A, on same general side, but on opposite flange. Note generally poor condition of concrete and decreasing width of flange.



31. Pile on Bent #40, Row B. Hole is immediately under cap. Note decreasing width on each of the three visible flanges.



32. Mudline photograph showing cleaned and uncleaned sections. Note the difference in types of marine growth. Also note absence of pits.



33. Cleaned section of web. Note the large pit upper right, as well as small pits upper left.

# REFERENCE

Hosford, H.W. "Cathodic Protection of Marine Structures", Harco Paper HC-16, Harco Corp., Medina, Ohio

Rogers, Howard T., "Marine Corrosion Handbook", McGraw-Hill, New York

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